SOUTHERN HORTICULTURE ENTERPRISES

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EDITOR'S PREFACE

A special book on horticultural crops is needed for the southern region because climate and soil both have much effect upon these crops.

In selecting the enterprises for the present text careful consideration has been given to those which have shown good financial returns in the South and which offer promise to growers. The vocational plans for choosing projects have been considered. Enterprises on Irish potatoes, sweet potatoes, and corn are considered as field crops and are treated in *Southern Field-Crop Enterprises* in this Series.

The job-analysis plan of treatment has been followed. This plan has been strongly advocated by vocational teachers and other leaders. The flattering reception of the other books of the Enterprise Series, all prepared on the job-analysis plan, shows the wisdom of continuing this form of presentation.

Each "enterprise" is rather complete in itself and few cross references are necessary. Each enterprise is analyzed into "jobs," each representing a farm unit which is also used as a teaching unit. The jobs are analyzed into their "problems."

The benefits of this job-analysis plan of presentation are numerous; some of them are listed:

- Saves teacher's time
- Saves students' time
- Systematizes instruction
- Follows logical sequence
- Holds interest of students
- Clarifies aims in recitations
- Aids students' memory
- Applies knowledge to practice
- Avoids serious omissions
- Connects class work with projects
- Connects class with farm interests
- Uses farming examples better
- Uses farm inquiries in school
- Sets aims for field trips
- Supplants many trips
- Follows seasonal sequence
- Enlists farmer's interest in school
- Makes assignments specific
- Uses reference material better
- Visitors grasp discussions better
- Fosters topical recitations
- Abolishes lecture methods

Teachers and supervisors, after many trials and comparisons with other plans of presentation, are convinced that the job-analysis plans have greatly improved the class work, the project

work, the reporting of projects, and the correlation of agriculture with other lines of work. Job analysis has clarified the thinking of students, teachers, and others in all the tasks concerning all groups: all-day, day-unit, part-time, and evening.

Other helps for teachers and students are offered in the form of suggestions along the following lines:

Activities	Arithmetical problems
Record-keeping plans	Bulletin references
Things to make	Book references
Debates	Charts

Recent Station findings and data have been included in the different enterprises and jobs. The text is really a new book in every sense. It is also vocational in spirit, method, and content.

The Appendix gives valuable data tables for easy reference. Book lists are classified and give dates, prices, and publishers. Students should make collections of books and bulletins for home libraries. These should be kept on shelves convenient for home study. Bulletins should be arranged by enterprises, in pamphlet holders, and neatly labeled.

The Authors.—Dr. Edward W. Garris was formerly Assistant State Supervisor of Vocational Agriculture in South Carolina, State Supervisor of Vocational Agriculture in Florida, and for a number of years has been Professor of Agricultural Education, University of Florida.

George P. Hoffmann was formerly Associate Professor of Horticulture at Clemson College, South Carolina, formerly Horticulturist for the J. C. Penney-Gwinn Corporation Farms, and for several years, Horticulturist with the United States Department of Agriculture.

Several definite purposes have been kept in mind by the authors in preparing this text for departments of vocational agriculture. They have planned to meet the needs of students and teachers. They have made it easy to maintain a close connection between classroom work and farm jobs. They have shown plans and led the way for tying up the successful experience of farmers with the training of the future farmers.

The authors and editor acknowledge the special service rendered by Dr. Monroe McCown, Assistant Chief, Deciduous Fruits Division, Fruit and Vegetable Branch, U. S. Department of Agriculture, in supplying certain technical information for the 1946 revision.

CONTENTS

SOUTHERN HORTICULTURE ENTERPRISES

INTRODUCTION—PLANT LIFE

Before taking up the special enterprises of gardening and fruit growing, let us make a rapid survey of the broader phases of plant life.

Importance of Plants.—All human life, and, indeed, all animal life, is dependent upon plants for sustenance. Most plants are able to obtain their nourishment from soil and air. The food thus produced is stored in the form of fruits, vegetables, and other crops, and is used for the maintenance of men and lower animals.

Without plants no animal life could long exist, for animals are not able to obtain their nourishment directly from soil and air alone.

Conditions for Plant Growth.—Because of the great value of plant growth to human life, it is quite necessary that we study carefully the needs of all plants and the special needs of all our crop plants.

The needs of plants may be grouped under six heads: (1) warmth, (2) moisture, (3) food supply, (4) air, (5) light, (6) freedom from enemies. If we are able to supply the best conditions under each of these heads we shall secure the greatest crops. The great problems of gardening and orcharding are to place the growing plants in such favorable conditions.

Warmth; Temperature.—Plants are not alike in their temperature requirements. Some grow in cold regions where snow and ice surround them. Others are found in torrid regions where frost never occurs. Wide differences are seen in the warmth required by our fruits and vegetables in the temperate zone. Lemons, oranges, certain grapes, and bananas can endure very little, if any, freezing weather, even in the dormant season. Peaches are more easily winter-killed than apples and pears. Garden peas and lettuce can endure cold, frosty weather, and do

not thrive well in hot weather. Melons and beans prefer the hot weather.

Moisture.—With respect to their water-loving habits, plants have been classified into three societies: (1) Xerophytes, or desert plants, such as cactus, sage brush, and mesquite. (2) Hydrophytes, or water-loving plants, as pond lily, cat-tail, water cress, and algæ. (3) Mesophytes, or mid-region plants, such as most of our garden, orchard, and farm plants.

The desert-loving plants have very extended root systems with which to obtain moisture, and a limited leaf surface and very leathery covering to reduce evaporation.

Water-loving plants have much more leaf surface than root surface. Some have no true roots.

The mid-region plants differ widely in their endurance of and requirements for water. The quince, for example, has shallow roots and can be made to grow on ground that is too wet for the peach.

Plant Food Supply.—Plants of the farm, garden, and orchard secure about 5 per cent of their food from the soil and the other 95 per cent from the air. Plants take mineral matter from the soil and organic matter from the air. That taken from the soil limits or controls growth more than the other. In other words, the soil supply is more limited than the air supply. If the mineral supply is increased the plant can take more organic matter from the air. There is practically no limit to the supply of organic matter which plants can take from the air, except that enough mineral matter must be taken from the soil to keep up the proper ratio of about one to nineteen, to suit the plant.

If a gardener increases the available plant food in the garden soil, the crop, in using that food, will also use about nineteen times as much from the air, with no additional cost to the grower.

The grower's problems are (1) to keep up the supply of plant food in the soil, (2) to make it available, (3) to make the soil conditions so favorable that the plant can secure the food, and (4) to keep other plants, as weeds, from robbing this food supply from the crop.

Plants Need Air.—Most crop plants need only the oxygen and carbon dioxide found in all air, but the legumes, such as clover, peas, and beans, also secure nitrogen either directly or

indirectly from the air. Very many experiments with plants grown without a proper supply of air show conclusively that plants must have a normal supply of its components.

How Oxygen and Carbon Dioxide are Obtained.—All the green-leaf plants breathe air into their leaves and green parts of their stems. They retain such parts of this as they may require. In daylight they retain chiefly the carbon dioxide, and a part of this is used to make starch and sugar in the cells of the leaves. The surplus oxygen is given off to the air again. At night the plant uses more oxygen than carbon dioxide. It then breathes off the latter into the air.

Light Requirements.—As just stated, the presence of light is necessary for the making of starch and sugar in plant cells. The green color bodies called *chlorophyll* are also necessary. A green plant, growing in the sunlight, is truly a starch and sugar factory. The products of this factory are used by the plant to build up the tissues, and this is called growth. We see, then, how essential sunlight is to plant growth.

Leaf Function and Structure.—The leaves may be considered as both the breathing organs and digestive organs of plants. There are numerous openings, or mouths, called *stomates,* more numerous on the under surfaces. Through these the air containing oxygen and carbon dioxide is admitted and the by-products are given off. In the daylight the chief waste is oxygen, because "food getting" exceeds the "breathing." In the darkness the chief waste is carbon dioxide, because "breathing" exceeds "food getting." The soft cells inside the leaf are provided with many small bodies bearing green chlorophyll. This gives the green color to the leaf. The upper and lower layers of epidermis are composed of transparent cells through which the light passes readily.

Germination of Seeds.—The first growth from seeds is called germination. The term "sprouting" more properly refers to breaking through the ground by this early growth. The seed contains the minute parts of the young plant. There is a store of plant food either (1) in the seed leaves, as in beans and peas, or (2) surrounding the parts of the plant, as in morning-glory seed. This store of nourishment provides for the growth of the plant until it has developed enough to get its nourishment from the soil and air.

Best Conditions for Germination.—A proper amount of moisture is necessary to soften the seed coats and to provide for the circulation of food which the seed contains. With many kinds of seeds, such as melon, carrot, parsnip, salsify, celery, and apple, it is a very great aid to germination to soak the seeds in water for a few hours before planting.

Seeds of radish, lettuce, garden peas, onions, and other plants which endure frost well will germinate at rather low temperatures. On the other hand, such seeds as corn, bean, tomato, and melon will germinate much better if the soil is rather warm. It is for this reason that such crops are started in warm weather.

Air in the soil is necessary for the best germination of seeds. They will not start well in soils that are so wet as to exclude the air. A seed-bed should be well loosened by plowing or spading, to allow the free access of air.

The purposes of leaves are (1) to expose the green chlorophyll of the plant to the sunlight, (2) to "breathe" carbon dioxide and oxygen, and (3) to manufacture starch and sugar. The work of leaves has already been described.

Important Work of Roots and Root-Hairs.—The chief purpose of plant roots is to take in food from the soil. The root-hairs are far the most effective in this work. The plant food taken in by roots must be in solution in the films of soil water which cling around the grains of soil.

The root-hairs are very numerous on the smaller rootlets, particularly on the young growth. They form a velvety covering of the roots and greatly increase the absorbing surface (Fig. 1). It is through the root-hairs that all, or nearly all, the food from the soil is taken into the plant.

How Roots Absorb Food.—Liquids may pass through a membrane by a process called *osmosis*. When two liquids are separated by a membrane they tend to trade places and mingle with each other. The thinner liquid passes through the membrane faster than the denser liquid.

The soil water containing some plant food in solution will thus enter the plant through the root membrane. A little waste material from the cell sap will escape at the same time. This trade of the two liquids through the surface of the root is necessary for the growth of the plant. If there be enough moisture in the soil the flow inward far exceeds the outgo, and growth will be

rapid. When the soil is very dry growth is retarded, and in extreme cases the plant may actually lose as much or more than it receives. Then it will wilt and may die. Rainfall or irrigation will dilute the plant food in the soil and rapidly increase the osmotic action through the roots. Growth is thus greatly increased. Try an exercise as described under figure 2.

FIG. 1

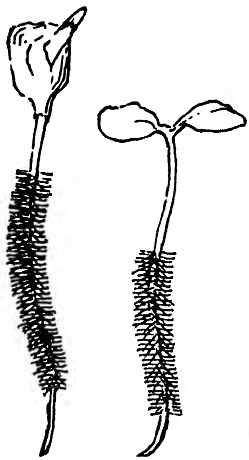


FIG. 2

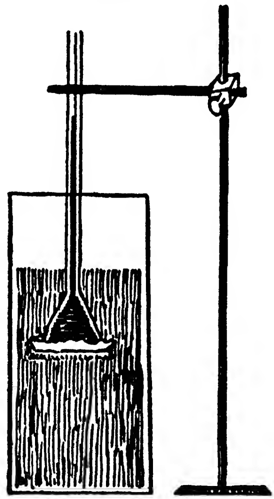


FIG. 1.—Root hairs form on all young roots except at the tip. They greatly increase the absorbing surface of the root.

FIG. 2.—Osmosis apparatus. A funnel tube with mouth closed by an animal membrane, then filled with thick syrup and suspended in water.

Plant Food.—The plant requires a number of elements which it gets from the soil, such as nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), sulfur (S), iron (Fe).

The first four of these are most likely to become deficient in any garden or farm soil. Usually they must be replenished by the grower.

Other elements required by the plant that are taken largely from the air, as already described, are oxygen (O), carbon (C), and hydrogen (H). Really the oxygen and hydrogen are taken chiefly in the form of water (H_2O) which enters the soil from the air and is then taken up by the roots.

Evaporation from Leaves.—As the plant food from the soil must be very dilute at the time it is taken in by the roots, it is evident that much surplus water is taken into the plant. This water aids in the circulation of foods in the plant. All that is not needed is evaporated from the leaves into the air. This process is called *transpiration* of water. This takes place through the little mouths, or *stomates,* which are so abundant on the lower surfaces of leaves.

Importance of Leaves.—The great importance of the leaf growth on all our common leaf-bearing plants may be understood when we realize that (1) the leaves make the starches, sugars, and similar products for the plants, constituting about 95 per cent of the food of the plant; (2) it is through the leaves that the necessary breathing takes place; (3) the leaves give off to the air the surplus water no longer needed by the plant.

The increasing of leaf growth which is to accomplish all of these purposes is often the main effort of the orchardist and gardener. The use of manure and nitrogenous fertilizers aids in the leaf growth. Leaf-eating insects must be kept in control to prevent the destruction of leaves. Pruning may direct the growth in the best parts of the plant.

Bud Formation.—On all plants the leaves are formed from the unfolding of buds. On the woody plants the buds are formed chiefly in the angles of leaves. They form on the new growth of shoots in spring and early summer, soon after the leaves of that year are well developed. They become more plump later in the year, and really prepare for winter during the last half of the summer season.

The preparation for winter of fruit trees and other woody plants usually consists of all or nearly all of the following processes: (1) Buds are formed and covered with winter scales for protection from changes of weather. (2) Hairy or waxy growth is provided to keep out water and ice. (3) In the fall the leaves drop off and the leaf scars are sealed with a corky growth. (4) The green parts of the twigs form thicker bark. (5) The breathing pores on the twigs become closed with corky growth called *lenticel spots.* (6) The buds and twigs become drier by the retreat of sap. (7) The starch and other forms of stored plant-food become fixed in the buds, pith, and elsewhere.

Two Kinds of Buds.—Nearly all woody plants, notably the

fruit trees and shrubs, form two kinds of buds—one kind for the formation of flowers and fruit and another for the growth of shoots.

PROPAGATION OF PLANTS BY MEANS OF SEEDS

Nearly all farm, garden, and orchard plants are of the seed-producing type. Other plants that do not produce seeds are represented by mushrooms, mosses, and ferns. These bear spores instead of seeds. A true seed contains the embryo of the plant which it is to produce. Spores do not contain plant embryos.

Why Seeds Are Produced.—There are several reasons for the production of seeds.

1. Seeds will live over winter better than the plants themselves. Many plants, called annuals, die in the autumn; this kind lives over winter only in the seed form. Examples of this group are tomatoes, corn, beans, melons, and many other farm and garden plants familiar to all.

2. Seeds are borne also for the purpose of increasing the number of plants. The number of seeds produced by a single plant is indeed surprising. If we count the number of seeds borne by one strawberry and multiply that by the number of berries on the plant in a season, we will find the product running up into many thousands. Similar results will be found with nearly all plants. Take the tomato, squash, watermelon, cucumber, blackberry, and currant as examples.

3. By bearing seeds which are easily distributed, plants provide for their spread over extended areas. With many kinds of seeds there are edible portions, as berries and other fruits and vegetables. The edible portion induces animals to carry them away for food and thus spread the seeds. Some seeds, as carrots, parsnips, and lettuce, are carried by the wind or will float on water to distant places. The nourishment borne by seeds also nourishes the young plants at germination time.

How Seeds Are Produced.—Flowers of some kind must always precede the bearing of seeds. In other words, flowers produce the seeds. The essential parts of the flower are the stamens and pistil. The seeds are borne by the pistil as a result of the pollen growth after reaching the pistil (Fig. 3).

Other parts of the flower are the more or less leafy growth around the stamens and pistil. These are the petals and sepals

and are not found in all flowers. They may serve to protect the essential parts or to attract insects.

Flowers of Several Types.—In some cases the stamens and pistils are borne in separate flowers, on the same plant, as in the cases of Indian corn, cucumbers, melons, oaks, walnuts, and many others. These are *monœcious* flowers. In other cases the two kinds of flowers are on different plants and are then called

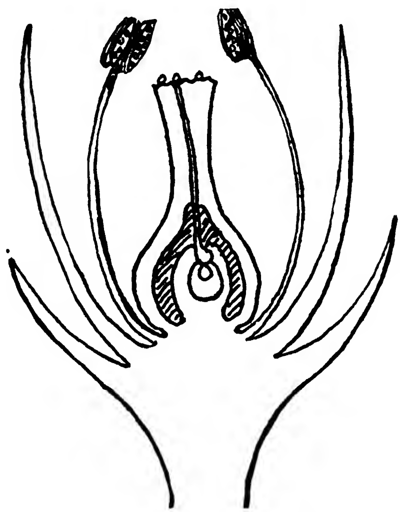


Fig. 3.—Section of perfect flower, showing pistil in center with growth from pollen grain reaching the ovule. Stamens shed the pollen. Petals and sepals serve as protection and sometimes attract insects to carry pollen.

diœcious. Familiar examples are paper mulberry, willow, poplar, and muscadine grapes. In such cases only the pistillate plants bear seeds.

When stamens and pistils are in the same flowers, the flowers are called *perfect*. (Fig. 3.) We find perfect flowers in peaches, plums, apples, pears, quinces, and the common bush fruits. Strawberries have perfect flowers in structure but in many varieties the stamens do not develop pollen which will grow on reaching the pistils. Such varieties must have others growing near them which have good pollen.

Methods of Pollination.—When flowers have both stamens and pistils they may be self-pollinated, and this is very frequently the case. But there are very many varieties of orchard fruits in which the pollen does not grow well on pistils of the same variety. Thus we get better crops of fruit if several varieties of apples which blossom at the same time are grown together. This is often true of peaches, pears, and plums.

There are several distinct plans in nature to prevent self-pollination even in flowers which have both essential organs. These plans are to help enforce cross-pollination.

1. The stamens may scatter their pollen before the pistil is ready to receive pollen.

2. The pistil may be mature first and may have received its pollen from another flower before the stamens in its own flower have shed any pollen.

3. In erect flowers, the stamens are sometimes lower than the pistil and the pollen does not fall readily upon the stigma of the pistil.

4. In flowers which droop, the stamens are sometimes so much longer than the pistil that the pollen falls away from the pistil instead of upon it.

Cross-Pollination.—Cross-pollination is necessary not only in the four types mentioned above, but also in the many kinds which have the stamens and pistils in separate flowers.

There is considerable cross-pollination in nearly all flowers. In many cases, as orchard fruits already mentioned, the pollen carried from one plant to another may be more likely to grow well.

How Pollen is Carried.—There are two general methods by which pollen may be carried from one flower to another, whether these be on the same plant or on different plants, viz., (1) by insects and (2) by wind. Of course pollen may be carried by hand on a soft brush. This is often done in greenhouses and where crossing of two kinds is desired.

Pollination by Insects.—When insects, such as honey bees, are in search of nectar or pollen itself, they visit many flowers of the same kind and carry pollen from one to another. The pollen on their bodies and appendages is rubbed against the stigma of the pistil and the cross-pollination is complete.

Flowers which insects like to visit have (1) sticky or heavy

pollen, (2) are showy by having colored sepals or petals, or (3) bear nectar, and (4) are often fragrant. Usually all four of these characters are found in flowers pollinated by insects. Common fruit blossoms are nearly all examples of this type of flower.

Pollination by Wind.—When the pollen is to be carried by the wind it becomes dry and powdery and is comparatively light. The flowers have no need for being showy and no nectar or fragrance is found. Corn, grasses, some small grains, plantain, and many weeds are examples of flowers pollinated by wind.

Seed Selection.—In deciding just what seeds to save, some attention must be given to the points desired in the crops. With many varieties earliness and resistance to disease are very desirable. Mark those plants which are desirable and save seed from those.

In all crops choose seeds from the best plants and the next crop will be much improved.

Storing Seeds.—Suitable places for storing seeds may be found in every home. They must be sealed in envelopes or boxes, or these containers may be put into cans or jars with tightly fitting covers. This will keep out weevils, moths, and mice.

They should be stored in a very dry place—near a chimney in the attic may be best. After all surplus moisture has dried away, freezing does not hurt them.

Seed Treatment.—The best materials for treatment of seeds are organic compounds of mercury, sold under several trade names. The chief one used in trials is Semesan, containing 35 per cent of mercury chlor-phenol-sulfate. This may be used as liquid or as dust. Others tested were Bayer Dipdust, Uspulun 30 per cent (liquid only), and Semesan Jr., 10 per cent (dust only). Germisan is the trade name of a similar material.

A number of vegetable crops have been tested at the Geneva, New York, Station (Bul. 554) and elsewhere. The treatment of seeds aids greatly in controlling seed-borne diseases and, in some cases, soil-borne diseases. Surprising developments were increased percentages of germination of all vegetable seeds tried except lettuce and spinach. The greatest increases occur with early plantings, when soil conditions are unfavorable for rapid

germination. When soils are warm and germination is naturally rapid, treatment does not appear to increase the percentage of germination, but it is still recommended to control seed-borne diseases. These new materials are apparently much preferable to formaldehyde, corrosive sublimate, and copper sulfate.

Experiment stations have shown the advantages of treating not only seeds of corn, small grains, sorghums, and beets and other root crops, but also seeds of vegetables of many kinds, such as beans, peas, melons, cucumbers, radish, cabbage, tomatoes, celery, and onions.

Treatment with semesan in a ¼-per-cent water solution is administered as follows: spinach, radish, lettuce, cabbage—one hour; tomato, celery, cucumber, melon—one-half hour. Any directions given on packages should be followed, however, for the times of treatment vary somewhat with the strengths of solutions. Most field seeds are probably not injured by treatment for one hour.

PLANT BREEDING AS APPLIED TO HORTICULTURE

By plant breeding is meant the systematic raising or reproduction of plants either with or without an aim toward improvement. When gardeners or orchardists observe certain individuals or types with characteristics which should be perpetuated, they may select these individual plants for breeding purposes. The points observed will probably be more or less noticeable in the offspring.

Causes of Variation.—It is said that no two plants are exactly alike. There is constant variation in nature between individuals even of the same kind. These differences may or may not be noticeable to the grower. This tendency to vary from each other makes it possible for the plant breeder to select characteristics which he desires. This gives rise to new varieties and new strains. Careful observation is required to select the desired types. It is necessary to keep these ideals constantly in mind in establishing new varieties.

Among the causes which tend to make plants vary may be mentioned (1) shade and sunlight, (2) differences in soil and variation in plant food, (3) proximity of other plants, that is, crowding or the reverse, and (4) weather and climate. Dande-

lions growing in dense high grass will grow tall; those growing in closely mowed quarters blossom near the ground. Many variations occur in nature which cannot be explained by any of these causes.

Survival of the Like and Unlike.—Heredity is one of the most important factors for the plant breeder to study. This is the law, that all creatures inherit from their ancestors certain forms, characteristics, and qualities. The law of heredity may be expressed briefly by saying that "like produces like" and "similar produces similar."

Heredity and natural variations are the two fundamental factors which, when placed in the hands of the skillful breeder, will attain wonderful results. Varieties without end are formed, and yet these become so well established that the grower can confidently depend upon their reproduction in garden, orchard, or farm work.

If the survival of the like were an absolute law there would be no possibility of change and all our plants would be alike. The environments of the plants set up variations, and we may find that plants which are unlike are descendants from the same parents. These various forms may suit the different environments into which they fall, and the result is a survival of the unlike. Take the muscadine grape, for example. We find in nature numerous varieties, all apparently traceable to the same common parentage. By the aid of men, the varieties found among all garden and orchard plants are greatly improved and their characteristics fixed more firmly.

Extreme or Sudden Variation.—*Mutation* is a name given to any extreme or sudden variation from a type which we have been growing. The term *sports* is sometimes applied to these sudden variations. It has been fairly well established by De Vries and others that the characteristics shown by mutations may be inherited by their offspring. Thus extremely different new varieties may be established somewhat quickly.

Careful Selection.—The plant breeder finds it necessary to destroy hundreds of individuals in the selection of a few which meet his ideals. Special skill is required to do this. He must observe the many ways in which the individuals vary. He must weigh in his mind the practical points and the fanciful points.

It is necessary for him to choose among these and retain those most desired. Such elimination of plants not true to type is called *roguing.*

Hybrids.—New forms are often created by crossing rather distinct forms. Pollen taken from one variety of apple and crossed on other varieties produces seeds which are called hybrids. A Japanese plum of one variety may be crossed with a variety of European plum or American plum. The resulting offspring would be a hybrid. This method of producing new varieties of plants is quite commonly practiced by plant breeders.

The process of pollinating the pistil of one plant with pollen from another is quite simple. A soft camel's hair brush is rubbed on the stamens to secure the pollen. This may be dusted into a small vial and properly labeled. When it is carried to the plant bearing the pistils the flowers must be emasculated; that is, the stamens should be clipped out with a pair of fine-pointed scissors before the pollen is shed on the pistil. The new pollen from the vial is then dusted on the pistil with the soft brush. Paper bags tied over the flowers will keep away foreign pollen which might otherwise be brought by bees and wind.

Pedigreed Seed.—Gardeners saving seed from their own plants know the history of those plants better than when seeds are purchased elsewhere. If plants of one variety, tomatoes for example, are grown in the home garden, the grower knows that there have been no tendencies to cross with other varieties. The seed is perhaps purer than any he could buy from the neighbors or growers where several varieties are produced. The term "pedigreed seed" simply means that the producer of the seed has knowledge of the parents, grandparents, etc.

Size and Weight of Seed.—If several samples of garden seeds are sorted by means of sieves into different sizes, it will be found that the largest seeds will give best results. With grains which are usually weighed instead of measured when purchased, it has been found that those which weigh heaviest for the measured bushel are most productive.

The lesson to be learned here is that we should select the heaviest and best seeds when saving or buying seeds to plant.

Seed Associations.—In many states there are associations

formed to encourage the production of better seed. Conditions and standards are formulated. Growers who meet these conditions in the production of pure-bred seed are given certificates of standard. These certificates serve as guarantees of purity and quality, and aid buyers in procuring the best.

CABBAGE AND CAULIFLOWER ENTERPRISES

Collaborator: H. H. Zimmerley, Ph.D., Director, Truck Station, Norfolk, Va.

Cabbage is a member of the mustard family. This familiar garden vegetable has been developed, through selection, from a wild plant. It is reported that wild cabbage plants still may be found on the chalk cliffs of England. The cauliflower is a race of cabbages with a swollen and distorted blossom. Brussels sprouts are cabbage plants which bear many small heads along the central stem.

Cabbage is adapted to a wide range of soil types and climatic conditions and therefore is an important food crop throughout the world. It is available on the market at all seasons and is important as a processing crop as well as for sale for fresh use.

Analysis into Jobs.—Following are the managerial and operative jobs or teaching units in enterprise with cabbage and cauliflower and their near relatives.

Job 1. Determining Possibilities with Cabbage or Cauliflower

Conditions Usually Found.—These crops are grown in limited areas and usually produce good yields.

Aims.—Growers should know the requirements for these crops and what profit they might be able to make.

Problems for Study and Discussion

1. Find the acreage devoted to each of these crops in your community.
2. Find the length of time required to grow a crop of cabbage or cauliflower.
3. Determine the average cost of growing an acre of cabbage or cauliflower.
4. What are the average yields to expect?
5. Find the average prices to expect.
6. Enumerate the cost factors, and the factors which affect yield.
7. How can you secure the capital for growing these crops?
8. What special labor requirements will be needed?
9. Talk with local growers as to the advisability of growing these crops.
10. To what extent are local growers increasing or decreasing their growth of cabbage or cauliflower?

Activities.—From the U. S. Yearbook of Agriculture calculate the average production of winter and early spring cabbage for the last three years. Compare this with the three preceding years. Compare prices likewise. Show results on a graph.

Where These Crops are Grown.—Cabbage and cauliflower may be grown in the home gardens in all sections of the United States. Many of the northern states produce the fall crop of

FIG. 4.—Two-acre cabbage project of a vocational student, planted in fall, to be marketed in early spring.

cabbage which is sold during the entire winter. New York, Colorado, Wisconsin, and Michigan are the leading states. In southern states cabbage is set out in the fall or winter and sold later as fresh cabbage. The leading states for the winter crops are Texas, Florida, Arizona, and California. Many of the southern

FIG. 5.—J. C. Eberwine, Nânesemond Co., Va., grows twenty-five acres of early cabbage for northern markets. He believes in improved practices and has sent four sons to study agriculture. (Seaboard A. L. Ry.)

states, as South Carolina, produce early spring cabbage. Cauliflower will not do well in warm weather, and only the late crop of cabbage will endure summer heat (Figs. 4 and 5).

The cost per acre varies from year to year on the same farm. The cost factors which vary are the amount of fertilizer used, the cost of seed or of plants, the cost of spray materials, and the cost of labor. The costs per acre probably range from $90 to $150, not including the cost of crates for shipping to market.

Job 2. Choosing Varieties

Conditions Usually Found.—Growers usually select one variety which meets the demands of the market.

Aims.—The best market varieties for cabbage and for cauliflower should be understood.

Problems for Study and Discussion

1. Make a list of the varieties of cabbage grown in your community.
2. Which variety do the farmers grow for market?
3. Under what conditions would you grow a late variety?
4. What are the advantages of growing only one variety in a community?
5. What variety of cauliflower would you recommend? Give reasons for your choice.
6. What are the characteristics of a good commercial variety?
7. Why are late varieties grown more in northern than in southern regions?

Activities.—Learn to know varieties by examining in fields, in markets, and comparing with catalogs.

Variety of Cabbage to Grow.—The most important varieties of cabbage used in the trucking sections of southern states are the Jersey Wakefield and the Charleston Wakefield (Fig. 6). The Jersey Wakefield has a small and somewhat pointed head. In some places the late varieties, such as the Succession and the Flat Dutch, are used. The latter is suitable for home winter storage. Copenhagen Market is a good medium-early spring variety with a round head. It should not be carried over winter in the field as this would cause it to produce seed shoots instead of heads in the spring.

Variety of Cauliflower to Grow.—There are only two varieties of cauliflower which are grown in southern states for commercial purposes: Early Snowball and Erfurt. The Early Snowball is the leading variety.

Job 3. Selecting and Preparing the Soil

Conditions Usually Found.—Growers select certain kinds of soil for cabbage and cauliflower, and prepare it well.

FIG. 6.—A class in agriculture and a group project, with Charleston Wakefield cabbage showing an even stand, clean cultivation, and thrifty growth, free from enemies. (J. G. Smith, Agr'l Teacher.)

FIG. 7.—A field of very early cabbage on rich soil, well tilled and fertilized, makes a promising crop for a vocational student. Insert: Cabbage plants ready for setting.

Aims.—The special soil requirements for these crops must be understood.

Problems for Study and Discussion

1. On what type of soil are cabbage and cauliflower grown in your community?
2. What are the advantages of plenty of organic matter?
3. What are the effects of liming the soil for cabbage?
4. Of what importance is proper drainage?
5. What kind of soil is considered early?
6. Enumerate the effects of lime on soil.

Activities.—Test soils for organic matter, and for acidity. Compare different types of lime.

Soils to Use.—Cabbage and cauliflower may be grown on a variety of soils, from sand to clay loam. The late varieties will

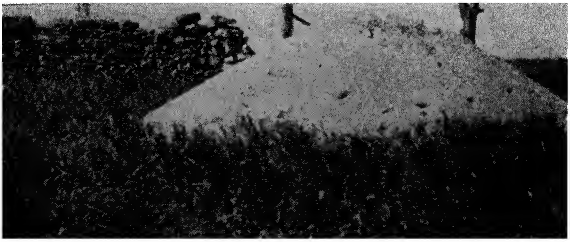


FIG. 8.—Preparing to lime soil in the rotation preceding the growing of cabbage.

probably do better on heavy soils or on muck soils (Fig. 7). The early spring crop does best on a sandy loam soil. The soil types in general use are "Norfolk sandy loam" and "Norfolk sand." These soils are good for the early crop but they do not hold moisture well enough for the late crop.

Organic Matter and Lime.—A rotation should be followed which will provide an abundance of organic matter in the soil for cabbage. In certain localities soils with plenty of organic matter should be limed (Fig. 8) for the cabbage crop. Heavy applications of manure are often followed by the use of lime.

Reasons for Rotations.—Give a good example to illustrate each of the reasons for rotation of crops as given on p. 20.

Preparing the field for planting is similar to that followed for other truck crops. Plow deep, turning under plenty of organic matter. Then disk the soil and let it settle. Harrow

two or more times one week apart. For fall crops of cabbage there is usually plenty of time for such bare fallow.

Good Rotations

Distribute labor
Destroy insects
Lessen plant diseases
Control weeds
Conserve plant food
Use fertilizer best
Aid in liming
May add organic matter
Improve tilth
Lessen erosion

Job 4. Growing Plants

Conditions Usually Found.—Those growing plants prepare seed-beds well for planting the seed. The seed is usually sown broadcast. Many truck farmers purchase plants from others.

Aims.—Growers should know how to grow good plants at the proper time. The buying and handling of plants should be understood.

Problems for Study and Discussion

1. What implements are needed in preparing the soil?
2. How deep should the soil be prepared?
3. How are the seed sown in the field?
4. How much seed will be needed to produce enough plants for an acre?
5. Review the effects of bare fallow before planting.
6. Under what conditions are plants started in hotbeds or cold-frames instead of in the open field?
7. Make a series of dates for planting and the corresponding dates for transplanting and marketing.
8. Find out where growers of your community usually secure their plants.
9. What is the average price per thousand for plants?
10. How are plants pulled from the bed?
11. Give directions for properly handling plants after pulling.
12. Give a rule for calculating the number of plants required for an acre.

Activities.—(1) Practice growing plants for sale and for home use under favorable conditions. (2) Make cold-frames and grow these kinds of plants for field use.

Where to Secure Plants.—Plants are grown for sale by people in many sections. The names of such growers may be secured from advertisements in farm papers or from your county agent. The growing of cabbage plants is an important com-

mercial enterprise in Meggett, S. C. Growers there are able to furnish plants in car-lot shipments.

Many of the growers plant the seed and grow their own plants. The plants are taken directly from the seed-bed to the field for transplanting.

Number of Plants Needed.—The number of plants needed to set an acre depends upon the variety and the width between rows. If the rows are three feet apart and the plants are set fifteen inches apart, it will take 11,616 plants per acre. Each plant occupies a space of 3 x 1¼ feet or 3¾ square feet. If the rows are wider and the plants set farther apart, less will be needed. On an average, growers use from 7,000 to 8,000 plants per acre. The square feet occupied by each plant is divided into the number of square feet in an acre (43,560) to determine the exact number of plants per acre. Some allowance should be made for resetting and for inferior plants.

Propagating Plants.—Southern growers usually sow the seed broadcast over the soil. The seed are sown thinly in order to produce stocky plants. In some places, the seed are sown in drill rows. A protected spot for this nursery bed is often chosen. Exposure to sun and shelter from cold winds are desired.

Under normal conditions, about one-fourth of a pound of cabbage seed should produce enough plants to set an acre, but growers usually allow one pound of seed to produce plants for an acre.

In some southern sections cabbage seed is sown in hotbeds or cold-frames rather than in the open field. This practice is necessary where freezing temperatures are expected before the plants become hardened.

The time to sow seed varies for different sections and upon the time the grower desires to set the plants in the field. For early spring crops the seed is sown in late September or early October, in order to have plants ready for transplanting in December. In many communities, the plants are set in the field in September, October, or November to produce cabbage for the winter markets. In such cases, the seed has to be planted in August or early September. The early varieties of cabbage will mature for market from seeding in 100 to 120 days.

Cauliflower requires approximately 120 days to mature from the time the plants are set. Both of these crops do best in

southern states when grown during the cooler months. Seed should be sown in most places in the early fall.

Job 5. Setting Plants in the Field

Conditions Usually Found.—Plants are commonly set by hand. Some growers use machines for this purpose.

Aims.—How to set plants economically in the field should be understood and practiced by growers.

Problems for Study and Discussion

1. How do local growers usually set cabbage and cauliflower plants?
2. How many acres would you have to plant in order to pay for investing in a transplanting machine?
3. How fast are plants set by hand methods?
4. How far apart are plants set? Give distances for different types.
5. Compare different methods of setting.
6. Compare different methods of watering plants.

Activities.—Practice setting plants by two good methods and compare the costs and results.

Setting Plants.—Most growers set the plants by hand although a transplanting machine suits the job well. (Fig. 9.) If rows are marked off with implements which make suitable furrows, setting is rapidly done by the use of a trowel. (Fig. 10.) Each plant is planted by use of a trowel in a vertical position with the roots straight down, and the soil is pressed against the roots with the foot. Fresh, damp soil in the furrow may make it unnecessary to water the plants at setting time unless the weather is dry. If the soil is dry, it will be necessary to pour about a pint of water in the hole where the plant is to be set. The plants are set a little deeper than they grew in the seedbed. In dry weather it is advisable to prune off about half of the leaf area just prior to setting the plants.

Machines.—It is doubtful if a transplanting machine is a wise investment unless the grower has ten acres or more to set each year. The chief advantage of a transplanting machine is that it aids in watering the plants and may save some time.

Rows.—Plants may be set on the level or on ridges. The rows are usually spaced from 3 to 4 feet apart, and the plants are set from 15 to 24 inches apart in the rows.

December Planting.—In the trucking sections of Virginia and southward, and in some other sections where cabbage is grown for very early market, the plants are set in December

FIG. 9.—Transplanting machine used for setting plants. It opens the furrow, covers roots of plants placed by two boys riding behind, and water is liberated from the barrel for each plant. The driver sits above the barrel of water.

FIG. 10.—The double-row system of planting cabbage is shown. More hand hoeing is required in this plan.

on the south side of ridges. These ridges protect the plants from cold and from high winds during the winter. Growth of roots and plants begins earlier than when spring planting is practiced. (Fig. 11.)

FIG. 11.—Cauliflower in single rows, showing clean cultivation, and slight ridging to cover small weeds in the rows. (Seaboard A. L. Ry.)

Job 6. Providing Plant Food

Conditions Usually Found.—Growers have to give liberal fertilization to cabbage and to cauliflower.

Aims.—How to provide organic matter and how to choose, buy, and apply fertilizers should be well understood.

Problems for Study and Discussion

1. What is the value of organic matter for growing these crops?
2. What plant-food elements are usually needed?
3. From what sources or carriers are these fertilizer elements secured?
4. How much fertilizer would you use for cabbage or cauliflower?
5. How and when should fertilizers be applied?
6. Why is it best to apply some nitrogen after the plants have been set in the field?
7. What conditions require it?
8. What are the objections to using ready-mixed fertilizers?

Activities.—Practice home mixing of commercial fertilizers from formulas suited to your local soils.

Providing Organic Matter.—Cabbage and cauliflower are considered to be vigorous feeders. An application of from 5 to 10 tons of barnyard manure per acre is very good for these crops. When the plants are first set, it is best not to have very much available nitrogen in the soil. Too much available nitrogen will cause the plants to be tender and not able to stand cold.

Using Commercial Plant Food.—If no barnyard manure is used, a complete fertilizer is applied by many growers at the rate of 1,500 to 2,000 pounds per acre. Most growers use a 4-6-4, a 5-7-5, or a 5-10-5 (N-P-K) fertilizer. About one-half of the fertilizer is applied before the plants are set and the other half about the time the plants are half grown. If the plants are not growing rapidly, many growers apply about 200 pounds of nitrate of soda or sulfate of ammonia per acre when the plants are one-half or two-thirds grown. Many growers buy the commercial fertilizer ingredients separately so that the plants can be fed as desired. This is particularly true for the nitrogen carriers.

Job 7. Cultivating and Caring for the Crops

Conditions Usually Found.—Growers give these crops frequent shallow cultivation. Caring for the crop well is commonly found.

Aims.—How to care for and cultivate cabbage or cauliflower successfully and economically should be understood and practiced by growers.

Problems for Study and Discussion

1. What implements are needed for tillage?
2. At what time of the day is it best to cultivate? Why?
3. How often would you cultivate these crops?
4. On farms where cabbage and cauliflower are being cultivated what are the details of the operations?
5. Describe the blanching of cauliflower heads. When is this done?
6. Give directions to prevent the bursting of cabbage heads.

Activities.—Repair and sharpen cultivators and tools for this job. Run a trial to compare different methods of cultivation.

Cultivating.—All cultivation given cabbage and cauliflower should be shallow, to prevent injury to the roots. Cultivation should be frequent enough to prevent weeds or grass from growing. It is sometimes necessary to hoe cabbage but the most of the cultivation may be done with horse cultivators.

Cultivation should not be given in the early morning while the plants are covered with dew as there is then more danger

of leaves being broken. Cultivate in the afternoon or when the plants are dry.

Blanching Cauliflower.—If the sun is allowed to shine on the "curd" after it is formed, the color will be green in place of white. The curd will not be tender, and will be bitter. When the heads have reached the size of two or three inches in diameter, the outside leaves are tied up over the heads. The leaves may be tied with a cord or held up by using a heavy rubber band.

Preventing Bursting of Cabbage.—When heads become large and are growing rapidly they are likely to crack or burst open. This is especially true of the late varieties. Much rain is also likely to cause bursting. Cracked heads are unfit for market. The trouble may be largely prevented by bending the plants over enough to loosen some of the roots on one side, to check the rapid growth. This is done just before the cracking begins.

Job 8. Controlling Diseases and Insects

Conditions Usually Found.—Farmers have to combat several different diseases and insect enemies.

Aims.—Students should know how to identify each of these enemies and how to control them.

Problems for Study and Discussion

1. Find what insects are injurious to cabbage and cauliflower.
2. Identify each of these insects.
3. What control measures would you recommend in each case?
4. What insect is most injurious in your region?
5. Ask several growers what diseases they have to combat.
6. Which diseases may be controlled by treating the seeds?
7. What are soil-borne diseases? How controlled?
8. What is the chief remedy for air-borne diseases?
9. How may rabbit attacks be prevented?

Activities.—Collect and study the insects and diseases attacking plants of the cabbage family.

Diseases of the Cabbage Family.—Several diseases may attack any of the cabbage family. The root-knot, clubroot, black-rot, and black-leg are the most common diseases.

Root-knot trouble attacks many of our cultivated plants and fruits. The parasite may be carried from infested plants or infested soil. It enters the roots of plants near the tip and causes irregular swellings or knots. Plants with root-knot will fail to develop and will look sickly. Crop rotation is the only

practical control measure. The plants should be set in soil which is known to be free from this trouble.

Clubroot is very similar to root-knot. The knots formed are much larger than root-knot, and are often called finger-and-toe disease. The parasites causing this disease live over the winter in the soil. They are worse on a slightly acid soil. The application of lime some time in advance and the rotation of crops are about the best control measures. Avoid planting in beds or fields when these or related crops have been affected.

Black-rot may appear at any stage of growth from the plant bed to the headed plants. The first appearance is shown by the leaves turning yellow, then later turning black. All diseased plants should be removed just as soon as they are recognized. The seed should be treated with corrosive sublimate before planting to prevent spores being planted with the seed. The hot-water treatment of seed may be best.

Black-leg usually attacks the young plants before they are set in the field. The fungus kills the plants by clogging the stems and causes the plants to wilt. The fungus later develops fruiting bodies which contain spores capable of living over several years in the soil. Crop rotation is necessary if soils are infested. Treating seeds with hot water, with corrosive sublimate, or with semesan should help to hold the disease in check, but as spores are also carried beneath the seed coats, the hot-water treatment is best. Soak seeds for 30 minutes in water at 122 degrees F. Test seeds after treating as the hot water reduces germination.

Insect Enemies.—The main insects of the cabbage family are the harlequin cabbage bugs, cutworms, cabbage worms, and cabbage aphids.

The harlequin cabbage bugs are about one-half inch long, and are shiny black in color marked with red or orange dots. They feed on any of the cabbage family. The adults live over winter in weeds, trash, and old stems left on the field. The eggs are laid in the spring and summer and several different broods are produced. The damage is done by the insects sucking the juice from the plants. Sprays strong enough to kill the insects will usually kill the plants also. Clean-up measures should be used to kill the winter brood. A trap crop of mustard or

kale may be planted. When they collect on the trap crop, spray with pure kerosene oil.

Cutworms destroy plants soon after they are set by cutting them off just above the ground. They may be controlled by the use of poisoned bait. (See Appendix.) Frequent tilling of the soil for several weeks before setting plants will greatly reduce the number of cutworms.

Cabbage worms are the larvæ of an adult white cabbage butterfly, familiar to all vegetable growers. The worms are velvety green with a faint yellow stripe down the back. They

FIG. 12.—Vocational student dusted cabbages for control of cabbage worms, using arsenate of lead with nine parts of lime. (A. J. Geiger, Agr'l Teacher.)

eat the leaves of the cabbage, cauliflower, or related plants, and often injure the whole plant.

The worms may be controlled by spraying or dusting with arsenate of lead or arsenate of lime (Fig. 12). As cabbage heads form from the inside growth, none of the poison will injure human beings eating the heads.

Cabbage aphids are of two kinds, and are found on the under side of the leaves. The grayish aphids, or true cabbage aphids, are waxy and are harder to control; the others are usually yellowish in color. There are about seven broods each year and each female may give birth at each brood to forty or fifty young. Aphids suck the juices from the plants and do much damage. Practice clean cultivation, and spray with nicotine sulfate. The gray aphids are frequently more destructive and may attack

large plants. Use soap with the nicotine sulfate for this type of aphids, or use nicotine dust of 3 per cent strength applied heavily.

Rabbits.—These enemies of the cabbage family often eat the plants in early stages of growth. Fencing with poultry wire is sometimes necessary. Trapping rabbits with box traps baited with grain is often advisable. A good watch dog may help keep rabbits away.

Job 9. Harvesting, Grading, and Packing

Conditions Usually Found.—These crops are harvested by hand just as soon as they attain sufficient size.

Aims.—How to harvest, grade, and pack cabbage and cauliflower for market should be understood by growers.

Problems for Study and Discussion

1. When are cabbage and cauliflower ready for harvesting?
2. How are the heads cut from the stalks?
3. How are cabbage and cauliflower graded?
4. Describe the trimming of heads for different markets.
5. What kinds of crates are used for each of these crops?
6. How many heads in a crate?
7. How are cabbage and cauliflower packed in the crates for shipment?
8. Where would you prefer to do the trimming, grading, and packing for car-lot shipment?

Activities.—Practice harvesting, grading, and packing these crops. Visit some shipping point and assist in loading for car-lot shipments. Make up containers for these crops.

Harvesting Cabbage.—The heads are harvested for the early market just as soon as they reach marketable size. Those weighing from two to four pounds are the best for the market. The heads are harvested by a person going down the row and cutting the ones that are large enough. They are cut with a knife just above the first outer leaves. The amount of leaf protection left for the heads varies for different markets (Fig. 13). Most dealers prefer to do some trimming in the markets. Packing may be in the field (Fig. 14) or the crop may be hauled to the packing shed (Fig. 15).

Grading.—Cabbage heads are usually graded by the cutters in the field. It probably pays best to make two grades on the basis of weight. Defective heads should not be included.

Containers.—Heads are shipped in the 1½-bushel hampers, or they are packed in open mesh bags holding 50 pounds. The

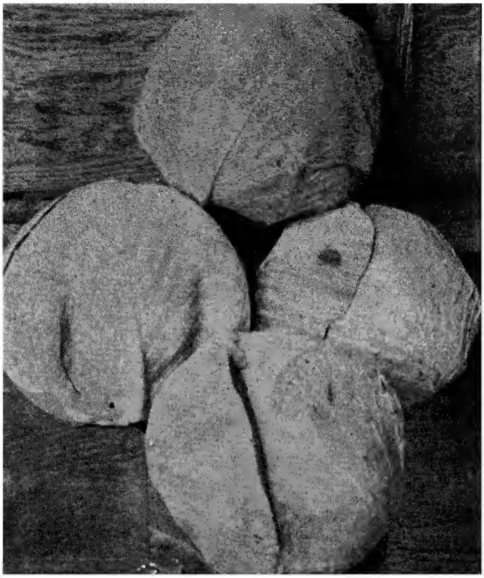


FIG. 13.—Late cabbage closely trimmed for shipment to market. (Seaboard A. L. Ry.)

FIG. 14.—Here the trimming and packing of hampers is done in the field during the harvesting of cabbage. Note the overhead irrigation system. (Lakeland Chamber of Commerce.)

FIG. 15.—Harvesting early cabbage, to be hauled to the packing shed.

FIG. 16.—Trimming, grading, and packing cabbage in 48-quart hampers. Above, a good type of packing shed; below, working in the open, loading truck to haul to car.

pointed heads, like the Wakefield type, are usually shipped in hampers (Fig. 16). The open mesh bags provide better ventilation and are cheaper than the hampers. Crates are used only occasionally (Fig. 17).

When the heads are packed in the hampers the first layer is placed butts down, and then the layers are alternated to the top. The butts and heads are not joined because of a stain which comes from the butts, which mars the appearance of the heads. When heads are packed in crates the stems or butts are packed outward.

Harvesting Cauliflower.—Just as the heads reach marketable size and have blanched properly they are harvested. They

FIG. 17

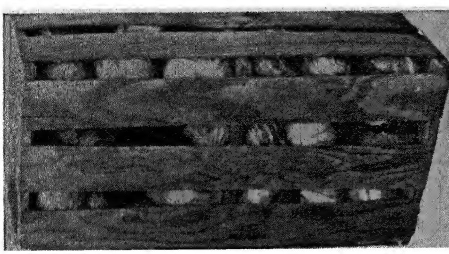


FIG. 18

FIG. 17.—Ventilated crates are occasionally used for shipping cabbage to market.
FIG. 18.—Hampers poorly put together, badly damaged when used for shipping cabbage.

are cut with a long knife and the leaves trimmed. The trimming is done with a long knife, cutting squarely across the leaves. The leaves are often left projecting about an inch above the heads. These stubs help to protect the heads from injury. For some markets less trimming is desired.

Cauliflower is usually graded into two grades. The U. S. Dept. of Agriculture recommends that two grades be used. Cauliflower is packed in various kinds of baskets, crates, and barrels. The crates used in many places are 13 x 15 x 23 inches. The heads are placed in the crates so that the curds face the center. Cauliflower should be shipped to market in refrigerator cars. The crates are packed as described for cabbage.

Loading Cars.—Cabbage and cauliflower are given 2-inch ventilation space between the rows; are double stripped; and are loaded 3 to 4 crates high, 7 wide, and 10 long. (Fig. 18.)

Job 10. Marketing the Crop

Conditions Usually Found.—The bulk of the crop is consigned to commission merchants in the various cities.

Aims.—How to market these crops most successfully should be understood.

Problems for Study and Discussion

1. What methods of marketing are used in your community?
2. From what sources could a grower receive daily market information?
3. What are the advantages of coöperative marketing?
4. What is meant by consigning a car?
5. Discuss the matter of local express shipments.

Activities.—Visit a shipping point and assist in the operations of handling and loading. Fill out bills of lading for cars.

Marketing Cabbage and Cauliflower.—These crops are usually sent to the market in car-lot shipments. In a few sections, crops are grown under contract, the prices being fixed before the crops are planted. Most of the growers in southern regions sell through commission merchants and take the risk of receiving favorable prices in the markets to which the shipments are made. Local express shipments may pay if the grower first establishes his market.

Job 11. Keeping Records

Cabbage and cauliflower records are easily kept on simple forms such as those shown in the Melon Enterprise. A trial set of forms should be filled by each student for practice. Data for this purpose may be obtained from a good grower.

Cabbage Calculations.—1. An agricultural student, by planting an early variety of cabbage, secured 50 cents a hamper better price than his neighbor. If his yield was 350 hampers per acre, and his neighbor's yield was 400 hampers per acre at 60 cents each, which had the greater income from 10 acres? How much?

2. What would be the cost of hampers in each of the above cases, at $20 per hundred?

3. A student by turning under a crop of green manure for cabbage soil increased the yield 20% over that of a near neighbor. If 300 crates of cabbage per acre were harvested, selling at $1.40 each, what was the value of the green manure?

4. In these problems, what would be the cost of crates at $30 per hundred?

5. What capital outlay on crates could a young man save if 40% of the cost in problem 4 is saved by self-labor in making crates from "flat" cut material?

6. What is the labor cost of growing a 10-acre crop of cabbage if soil preparation cost \$3, planting cost \$4, tillage cost \$4, spraying cost \$3 for labor, and harvesting cost \$5 per acre?

7. If this is 33% of the total cost of the crop, what is the total cost?

8. If the labor is 30% self-labor, what capital was required to produce the 10-acre crop?

CELERY ENTERPRISES

Collaborator: A. M. Musser, B.S., Associate Professor of Horticulture, Clemson College, S. C. Information furnished by R. F. Cooper, celery-grower, formerly teacher of Agriculture, Sanford, Fla.

Celery growing is an outstanding example of the production of stems for use as a food for man. The thick, fleshy stems bear but a relatively small leaf surface. Celery is a member of the parsley family.

Commercial production of celery is a relatively young industry in the United States, since celery was not widely grown for market prior to the beginning of the present century.

Rapid growth of the celery plants is essential to high quality. Rapid growth requires an adequate water supply and a relatively high nitrogen level in the soil. Unless the normal rainfall and the moisture storage capacity of the soil are such as to provide the water required for continued rapid plant growth water should be added by irrigation.

Analysis into Jobs.—The farm units in a celery enterprise are included in the following order of seasonal sequence.

Job 1. Determining Possibilities with Celery

Conditions Usually Found.—Celery is grown on a commercial basis only in restricted areas. It is usually profitable when grown by experienced farmers.

Aims.—The factors necessary for success with celery should be fully considered and understood.

Problems for Study and Discussion

1. What is the acreage devoted to celery growing in your community?
2. How much will it cost to produce an acre of celery?
3. What yields should a grower expect to make each year?
4. What is the average price per crate for celery?
5. What special labor requirements are necessary?
6. How could you obtain the necessary capital for growing celery?
7. What marketing facilities are available?

Activities.—Obtain production and price data for a chart, as suggested for cabbage.

Where Celery is Grown.—Small crops of celery may be grown for home use in every garden, but only a few sections have found it profitable to grow celery on a commercial basis. The leading states in order of celery production recently were California, Florida, Michigan, New York, Ohio, Colorado, and New Jersey. Celery grown in the extreme south is ready for market after the northern crop is consumed (Fig. 19).

Cost per Acre.—The cost per acre for growing celery is relatively high when compared with the cost of other truck crops.

FIG. 19.—Celery grown in the lower South may be ready to harvest in February or March, thus avoiding competition with the northern crop. (Sanford Chamber of Commerce.)

The cost, however, varies greatly from one section to another. Fertilizer is one of the principal items of cost in southern states. Growers usually count on celery costing them about $2.00 per crate. The cost ranges from $400 to $1,000 per acre and probably averages over $600 per acre. In states where little commercial fertilizer is used the cost would probably be reduced $100.

The yield per acre varies according to season, variety, soil, amount of fertilizer, and many other factors. The yields vary from 400 to 1,000 crates per acre. In some sections the average yield would be approximately 500 crates. At Sanford, Florida, the average yield is about 700 crates per acre.

Prices Usually Received.—The market price on celery varies from year to year and depends upon the amount of celery which has to compete on the market. The price ranges from $1.00

to $5.00 per crate, with the average price being around $3.00 per crate.

Special Labor Requirements.—The growing of celery involves a large amount of hand labor. The grower has to provide two men for every ten acres of celery for producing the crop. At setting time and at harvesting time extra labor is needed. It usually costs about $50 per acre for setting and 20 cents per crate for harvesting in addition to the two men for ten acres.

Job 2. Choosing the Variety

Conditions Usually Found.—Growers find it best to grow the self-blanching type of celery. Usually one or two varieties are selected.

Aims.—Varieties of celery for commercial purposes should be studied and the best selected.

Problems for Study and Discussion

1. What are the two different types of celery?
2. Why is the self-blanching type usually grown?
3. Make a list of the different varieties of celery grown in your community.
4. What are the main characteristics of a good variety?
5. Which variety would you select? Why?

Activities.—Compare the results from growing two varieties. Calculate the returns from each.

Types of Celery.—There are two types of celery, divided according to the methods used in blanching. One type is green in color and has to be blanched by pulling up the soil around the plant. The other type is known as self-blanching. This type can be blanched by using boards or specially prepared paper.

Varieties.—Growers in the southern region plant only the self-blanching varieties. Of these varieties the Golden Self-Blanching is used more than all the others. In some sections two strains of this variety may be found, one strain being tall. Local names are given to these strains. A strain which is resistant to blight should be used.

Job 3. Selecting the Soil and Field for Celery

Conditions Usually Found.—Growers have to be very careful in selecting the soil for celery.

Aims.—How to select the soil and field for celery should be understood.

Problems for Study and Discussion

1. On what type of soil is celery grown in your community?

2. How is organic matter provided for the soil?
3. After what other crop is celery usually grown?
4. What local growers practice systematic rotation of crops for celery?
5. Give the best rotation.

Activities.—On two farms compare the growths on two different types of soil.

Soils for Celery.—This crop will grow on many kinds of soil if suitable provisions can be made to furnish plenty of water. It is usually grown on a sandy-loam soil having an impervious subsoil of clay usually designated as hardpan. This hardpan should be about eighteen to twenty-four inches below the surface of the soil. Celery is also produced on muck soils.

Fields should be selected where some method of irrigation can be used in supplying the necessary water. The field should be nearly level.

Rotation Problems.—Celery growers deem it advisable to have large amounts of well-rotted organic matter in the soil. They often strive to plan a suitable rotation which will provide humus resulting from the plowing under of a sod crop or other green manure crop. Muck soils, naturally rich in organic matter, are sometimes used for celery several years in succession. Fields having sub-irrigation systems for celery culture are also often used year after year, but an annual green manure crop may be turned under if needed.

Job 4. Procuring Seed; Testing and Treating

Conditions Usually Found.—Growers depend upon purchasing celery seed from reliable seedsmen, and few of them ever test seed.

Aims.—Students should know where to secure good celery seed and how to test seed for vitality.

Problems for Study and Discussion

1. From what sources can you obtain good celery seed?
2. Why do growers seldom produce seed at home?
3. How much seed is needed to furnish enough plants for an acre?
4. Why is old seed not recommended for planting?
5. How would you test celery seed for vitality?
6. Give special reasons for treating celery seed.

Activities.—Compare two methods of treating celery seed. Test seed after treatment and before treatment.

Sources of Seed.—Only a small portion of the celery seed used in America is grown here. The bulk of the seed used is imported. The celery grower must depend upon securing seed

from a reliable seedsman. The celery plant is biennial and usually does not produce seed until the second year. Most growers find it inconvenient to produce seed at home.

Growers usually buy from six to eight ounces of seed for setting an acre, the amount depending on whether plants are to be grown in a greenhouse or in outdoor beds.

Testing and Treating Seed.—Celery seed can be tested by the rag-doll method as suggested for melons. The semesan treatment suggested for other vegetable seeds should be used, as it will increase the percentage of germination and aid in controlling blights. Without treatment celery is difficult to germinate.

Soak seed for half an hour in semesan. The older plan was to treat with hot water by soaking seeds for half an hour at a temperature of 115 to 120 degrees F.

Benefits of Testing Seed	Benefits of Treating Seed
Prevents wasting good seed	Kills seed-borne disease spores
Avoids necessity of thinning	Saves crops from diseases
Makes replanting unnecessary	Prevents infesting soils
Secures uniform germination	Prevents infesting seeders
Allows earlier cultivation	Increases germination percentage
Calls attention to bad features	Insures a better stand
Causes even growth all summer	Causes a quicker growth
Allows crop to mature evenly	Suits planting in cool soil

Job 5. Starting and Caring for Celery Beds

Conditions Usually Found.—Growers prepare and manage seed-beds successfully.

Aims.—Students should know how to prepare seed-beds and how to manage them to secure best results.

Problems for Study and Discussion

1. Report the sizes of plant-beds used by local growers.
2. Give a rule for size of bed and definite acreage.
3. At what time of the year should beds be started?
4. What are the best conditions for success in germination?
5. How are the seeds sown?
6. Why are seeds covered very little if any?
7. How are the young plants protected from the sun?
8. How are they watered?
9. What spray schedule is followed in order to prevent diseases?
10. How should celery plants be handled to prevent their going to seed the first year?

Activities.—Prepare, plant, and manage a celery plant-bed.

How to Prepare Beds.—The usual size for celery beds is four feet wide and as long as necessary. Allow ten square feet of bed for each acre to be set. The beds are ridged or raised about four inches high. The soil in the beds should be well pulverized and it is a good practice to work in some wood ashes and commercial fertilizer about ten days before sowing the seed. After the beds are prepared the rows are laid off about six inches apart by making a light impression with a marker. Beds started in late summer need not be heated.

Sowing the Seed.—Celery seeds are very small and even an experienced person may have trouble in sowing them evenly in the bed. The seeds may be mixed with fine sand, corn meal, or flour to help in sowing them evenly over the bed. One method is to punch small holes in the top of a tin can and use it as a salt shaker for sowing the seed.

After the seed is sown the bed is wet and kept so for eight or ten days. Do not cover the seed with soil. Some growers place burlap over the seed until they begin to germinate. Celery seed has low germinating power, sprouting is slow, and the percentage is low. Both soaking the seed in warm water and treating with semesan will aid germination.

It usually takes from sixty to ninety days from the time of sowing for the plants to be ready to set in the field. Seed sown in May or June may suit the cooler parts of the South. Seed started in August should produce plants ready for setting in the field in October for the lower South.

Protecting Young Plants.—Celery grows best under cool conditions. As the young plants are started in warm weather the beds should be protected from the sun and hot winds. A sheltered spot away from the prevailing hot winds is best. Lattice work or cloth placed at a convenient height may be used to shade the beds from the hot sun. The usual method is to build a frame around the bed and cover this with a good quality of unbleached sheeting. The cover must be placed high enough to allow ventilation for the plants.

How to Water Plants.—If the plant bed is located in a field where sub-irrigation is possible, moisture is easily controlled. The beds may be kept wet on top in any case by using a sprinkling pot. The person in charge should learn from experience

the exact amount of water that is needed. Careful watering and continuous, steady growth will aid in making plants thrifty and prevent running up seed tops the first years. (See Job 1.)

Spraying Celery Beds.—In order to keep down diseases it is a good practice to spray the plant bed about once a week with Bordeaux mixture. The first spraying should be given after the plants are a few weeks old; the strength of the Bordeaux should be weaker at first, gradually increasing in strength with the age of the plants, until the standard strength for Bordeaux mixture is reached.

Job 6. Constructing an Irrigation System

Conditions Usually Found.—When celery is grown in warm climates farmers usually supply water from streams or wells to fields, or use other means of watering.

Aims.—Students should know how to construct an irrigation system for celery.

Problems for Study and Discussion

1. Report the local forms of irrigation.
2. How many wells will it take to supply the water for a ten-acre field of celery?
3. Where should the wells be located?
4. List the materials needed for constructing a sub-irrigation system for ten acres.
5. What is the average cost for the wells and for constructing the sub-irrigation system?
6. What size of tile is best for the main? For the laterals?
7. How is the water turned into the laterals?
8. How may a tile system be used for drainage in time of wet weather?
9. Describe an over-head sprinkling system.

Activities.—Assist in the construction, repair, and maintenance of an irrigation system.

Irrigation Systems for Celery.—Facilities for watering celery aid greatly in overcoming the difficulties which warm climates present. When soil is kept in proper condition of moisture, warm weather is not seriously detrimental to celery (Fig. 20).

Few celery growers use anything except sub-irrigation for celery. The over-head system of irrigation may be used, but it is more expensive to construct, more expensive to operate, and does not provide for drainage in time of wet weather. The sub-irrigation system gives the grower almost complete control of the moisture supply (Fig. 21). This system cannot be used on muck soils.

Deep wells may be drilled along the Atlantic and Gulf coasts in many different sections. Abundant water may be secured at depths varying from 100 to 1,000 or 1,500 feet. Many of these wells are of artesian formation. The wells should be located on the high side of the field to provide for water flow. It may take about four wells for every ten acres of celery if the wells are two and one-half inches in diameter.

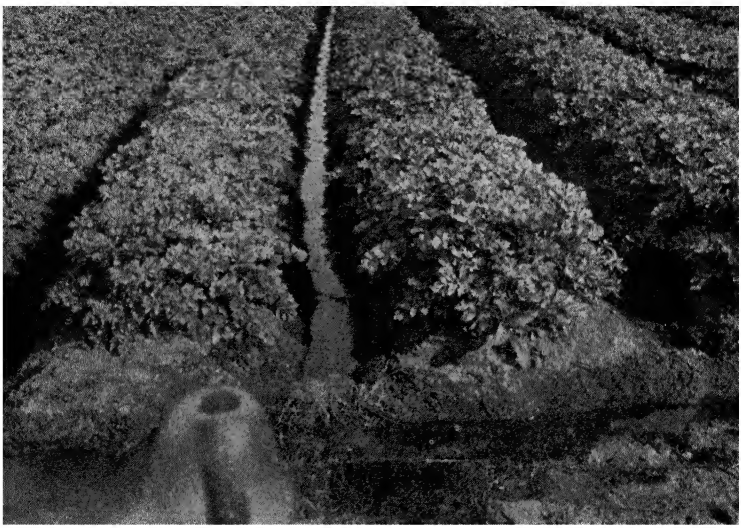


FIG. 20.—Celery rows grown in beds with irrigation furrows between beds. Water is supplied from an artesian well.

The Sub-Irrigation System.—The water main, constructed of twelve-inch tile, is laid along the high side of the field and given enough fall so that water will flow through it. Tees are placed in the main at intervals of about every twenty feet. From these tees or pockets three-inch laterals extend at right angles toward the field. All joints of the water main are made water tight with cement. The joints of the laterals are not cemented but are covered at each joining with some material to prevent soil from clogging the tile.

A stop pocket is placed at each tee to control the water of each lateral. The stop pockets are connected with the laterals and

with the drainage outlet tile which runs parallel with the water main.

Operating the System.—Water can be let into the laterals by removing a plug in the supply pocket. The stop pocket plug is closed to force the water through the joints of the laterals and to irrigate the field. In case of wet weather, the water from the flowing wells may be allowed to run on through the water main to a drainage ditch. The plugs are opened in the stop

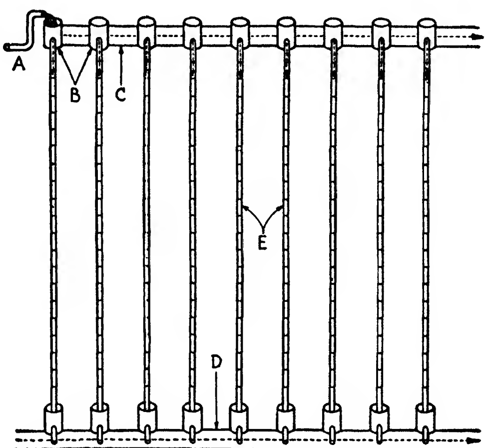


FIG. 21.—Plan of sub-irrigation: A, Artesian well or water supply; B, Supply pockets; C, Water main; D, Drainage outlet tile; E, Laterals.

pockets, which allows excess water in the field to flow through the laterals into the drainage outlet and thence to the drainage ditch.

Over-Head Sprinkling Systems.—Water may be supplied for such a system by pumping from a well or from a stream. The supply pipe may be run underground through the middle of the field at right angles to the rows and sprinkling pipes. A vertical pipe is connected about every forty feet to supply water to the sprinkling lines running to the right and left from the underground supply pipe. Special nozzles are screwed into the sprinkling pipes at intervals of three feet. Special unions are used to connect the sprinkling lines with the supply

pipes. This allows the lines to be rolled from one side to the other, and to sprinkle about twenty feet on each side, as needed.

Job 7. Preparing the Soil for Celery

Conditions Usually Found.—Growers are usually very thorough in preparing soil for celery. Some growers wait too late to give the proper preparation.

Aims.—The best methods of preparing the field for celery should be understood.

Problems for Study and Discussion

1. Discuss the need of planning for celery a year or two in advance.
2. How deep should the soil be plowed in preparing it for celery?
3. What implements are needed in preparing the field for celery?
4. What are the special reasons for maintaining a bare fallow for several weeks before planting?
5. What methods of preparation are used locally?
6. Describe a marker for celery rows.

Activity.—Construct a 3-row marker in the school or farm shop.

Early Preparation.—From a soil fertility standpoint, preparation should begin one or two years before celery is to be planted. Suitable soil-building crops should be plowed under long enough in advance to become well rotted. This is necessary for success if the soils to be used are not already in the form of muck or otherwise rich in humus. (Job 9.) Clean cultivation and effective control of weeds should be the rule if celery is to be planted.

Plowing and Harrowing.—Soil preparation should commence about the time the seed is planted in the beds in order to get it in good physical condition for the plants. The soil is usually run over with a disk harrow and then plowed with a good two-horse turning plow. It is a good practice to harrow the field every week or two until time to set the plants. The soil may be leveled with a plant drag before it is marked off into rows. Review the benefits of a bare fallow before planting, as given in the Corn Enterprise.

Marking the Rows.—The surface is leveled and a cord stretched to get the first row marked. The other rows are marked by a horse pulling a marker which marks several rows at a time. The marker is made with teeth set at three-foot intervals or as desired. The first tooth of the marker is run along the last-marked row each time and the other teeth mark new rows.

Job 8. Setting Plants in the Field

Conditions Usually Found.—Many growers do not take enough care in setting the plants.

Aims.—How to take celery plants from the bed and how to set them economically in the field should be understood.

Problems for Study and Discussion

1. What is the best method of taking plants from the beds?
2. What special care should be taken of the plants?
3. How many plants are needed to set an acre?
4. How are the rows marked off for celery?
5. Describe a good method of setting the plants.

Activities.—Practice setting celery plants. Time the work of different persons and of different methods.

Taking Plants from the Bed.—It is a good practice to soak the bed with water just before the plants are removed. Be careful in pulling the plants not to injure the ones which are to be left. Pull only the large, stocky plants. Those plants should be placed in a basket to carry to the field.

Number of Plants.—The number of plants needed for an acre depends upon the space between the rows and the distance apart of plants in the row. The distance between rows varies from thirty to forty-two inches and the distance between plants in the row from four to six inches. This will require from 26,000 to 60,000 plants per acre.

Setting the Plants.—Celery plants are set by hand. A grower usually employs a crew of fifteen or twenty workers who set plants for fifty cents per thousand. Some of the workers walk along and drop the plants while the others crawl on the ground and set the plants. Care must be taken to press the soil around the roots, and to see that the plants are not set so deep that the heads are covered.

After the field is set or after a certain number of rows is finished, the irrigation water is turned on to soak the soil thoroughly. Methods of setting plants with planting tongs are sometimes used.

Job 9. Providing Plant Food; Applying Fertilizers

Conditions Usually Found.—Growers often use green manure but find it profitable to use heavy fertilization for celery.

Aims.—The use of green manure and the kinds of fertilizers to use for celery and how to apply them should be well understood.

Problems for Study and Discussion

1. What is the value of green manure or other organic matter in the production of celery?
2. What kinds of fertilizers are used in your community for celery?
3. How much fertilizer is applied per acre?
4. How is the fertilizer applied and how many applications are given?
5. What are the advantages of coöperative buying of fertilizers?
6. Show how to calculate the materials needed in making a 5-5-5 fertilizer.

Activities.—In a project, run a trial to compare two plans of fertilizing.

Organic Matter.—Celery growers find that it is important to have plenty of organic matter in the soil. This organic matter may be applied by growing a crop of cowpeas, velvet beans, or other legumes on the field in the spring, or it may be added by applying barnyard manure, farm refuse, and other forms of organic matter.

Kinds and Amounts of Fertilizers.—There must be an abundance of available plant food in the soil if the celery crop is to make a rapid growth. The sandy soils used in southern states for growing celery are loose enough to allow leaching during heavy rains, making the constant application of fertilizers necessary. Growers do not all agree on the best kinds of fertilizers for celery. Some use a 5-5-5 formula and others use a 4-8-6 or a 6-2-8 (N-P-K). In many cases, ashes, castor pomace, tankage, and dried blood are used, in addition to a complete commercial fertilizer. A grower may be able to determine the best formula to use by testing several different ones on his particular soil.

The amount of fertilizer to use depends upon the fertility of the soil and the season. Growers apply from two to five tons per acre, including manures and commercial fertilizers. The average is about three tons. Nitrate of soda is often applied at the rate of two hundred pounds per acre as a side dressing (Fig. 22).

Job 10. Cultivating Celery

Conditions Usually Found.—Growers find that cultivation is needed practically every week during the growing season.

Aims.—How to cultivate celery thoroughly and economically should be understood.

Problems for Study and Discussion

1. Describe the best methods of cultivation of celery.
2. What implements are used to cultivate celery?

3. What special care is required?
4. How often is celery cultivated?
5. What are the reasons for cultivating the crop?
6. Discuss shallow vs. deep cultivation.

Activities.—In a project, run a trial to compare early and late ridging of the rows.

Cultivating the Crop.—Celery is a shallow-rooted plant and should be given only shallow cultivation. Care must be taken, especially while the plants are young, not to cover the hearts or buds with soil during cultivation. It is a common practice to cultivate deep while the plants are small, using a subsoiler to loosen the under soil and not disturb or move much of the surface soil. After the plants have attained some growth the

FIG. 22.—Celery on muck land near drainage ditch. Applying nitrate of soda to young plants.

spike-tooth cultivator is often used to prevent growth of grass and small weeds. Cultivation is usually given every week during the growing period until blanching begins. If this is well done there is little if any hand hoeing necessary.

Job 11. Controlling Diseases and Insects

Conditions Usually Found.—Growers find it necessary to fight a number of diseases and insect enemies.

Aims.—How to identify and how to control each of these enemies should be well understood.

Problems for Study and Discussion

1. What are the celery diseases which may attack the crop?
2. Describe each of these diseases and its injuries.
3. Why is prevention more important than cure of diseases?
4. Give preventive measures.
5. Make a list of the insect enemies of celery.
6. Describe each of these insects and its work.
7. How would you control each of these insects?

8. Find the cost per acre for spraying; for dusting.
9. What type of spraying equipment would you use for spraying celery?

Activities.—Make a table of the diseases and insects, with one column for effects and one for treatments.

Diseases of Celery.—The early blight, late blight, black-heart, and pink-rot are the main diseases of celery.

Celery Blights.—In some respects, the two blights are similar since each causes the plant to wilt away. The early blight first appears on the leaves as brown spots which later turn dark or grayish. These gray masses include the spores. The spots of the late blight are similar but the spores are black.

Resistant strains or varieties of seed should be selected. Bordeaux mixture is used for controlling the early blight and to help check the late blight. Farmers usually use the 4-4-50 formula of Bordeaux, except for spraying the young plants in the beds. It is probably best to use a 2-2-50 formula for spraying plant beds at first. Celery seed should be treated before it is planted, with semesan or with hot water, as a further safeguard against the blights. (See Job 5.)

Black-heart is a disease which attacks the young leaves of the growing heart, causing a black mass. The cause of the disease is not well known but experiments seem to indicate that the proper control of water will help to check it. High temperatures may also be one of the causes of it. No control measure can be suggested in addition to keeping the moisture content of the field under control, as is possible when sub-irrigation and drainage systems are installed.

Pink-rot may be detected first by dampening-off of the young plants. The plants fall over because the cell walls are weakened. A soft rot begins near the crown which later develops into a white, thick growth. The surface of the plant later turns pinkish and develops irregular black spores. These spores may live over in the soil and cause the disease the following year. The only safe way is to destroy all diseased plants and plan a crop rotation for celery.

Pithy stalks are often noticed by growers. These are unsuitable for food, and cannot be sold in markets. The trouble is an abnormal growth, perhaps less likely to occur when thrifty, steady growth is maintained. There is no fungous or bacterial

cause. Select the best seed stocks and strains of celery to prevent this type of growth, as the trouble is believed to be hereditary.

Running to seed is often a troublesome condition, resulting in ruined plants. Long periods of dry weather followed by heavy rains may bring on the trouble. Irrigation at the proper time would cause better growth. Careful selection of seed stocks is an important preventive measure.

Insects of Celery.—The main insects of celery are cutworms, leaf-tyers, plant lice, red spiders, and celery worms.

Cutworms cut down the young plants, especially in the plant beds and just after the plants are set in the field. They may be held in check with a poisoned bait. Several harrowings of the field before setting the plants usually destroys most of the cutworms.

Leaf-tyers often become abundant enough almost to cover the plants. They are biting insects which form webs and destroy the surface, which may turn brown. They attack many other garden crops. They may be killed by dusting with arsenate of lead or any of the other poison dusts. This should be applied before the insects inclose themselves in the folded leaves and webs.

Plant lice injure the plants by sucking the juice. If the lice get too bad they may be killed by spraying with nicotine sulfate.

Celery worms sometimes attack the celery crop, eating the leaves, and may practically defoliate the plants. Spraying or dusting with arsenate of lead is very effective.

Job 12. Blanching Celery

Conditions Usually Found.—All growers use some method in blanching celery before it is put on the market.

Aims.—Students should know the best and most economical methods to use in blanching celery.

Problems for Study and Discussion

1. How is blanching done for the green varieties?
2. Compare costs for blanching with soil and with boards.
3. How are the self-blanching varieties blanched?
4. Estimate the labor and cost of paper for this method.
5. How long does it take to blanch celery?

Activities.—Visit a farm and learn how to blanch celery; assist in the work. Practice blanching celery by soil, by boards, and by paper. Compare results and costs.

Blanching Celery.—The green varieties are commonly blanched by ridging up the soil gradually until practically the whole stalk is covered. Boards are used instead of soil in regions where lumber is not too expensive. Rows must be grown farther apart if the soil method of blanching is used. Green varieties are seldom grown for market in southern regions but are found in home gardens.

The Paper Method.—For the self-blanching varieties, celery is now often blanched by means of a specially prepared paper about ten to twelve inches wide (Fig. 23). The paper is placed

FIG. 23.—Blanching celery by means of tar paper, the single-row plan. (Sanford Chamber of Commerce.)

on edge and kept close up to the celery on the sides by means of wicket-shaped wires pressed into the soil at regular intervals. It usually takes from ten to fourteen days to blanch such varieties by this method, depending upon the weather and upon the maturity of the growth.

Job 13. Harvesting, Grading, and Packing

Conditions Usually Found.—Celery is harvested mainly by hand. It is often not graded nor properly packed.

Aims.—Students should know how to cut, how to grade, and how to pack celery by the best methods.

Problems for Study and Discussion

1. How can you tell when celery is ready to harvest?
2. By what method is celery cut?
3. What is the work of the trimmers?
4. How is celery graded? When is this done?
5. Why should celery be washed before it is packed?

6. Describe an economical method of washing.
7. What kinds of crates are used for packing celery?
8. How is celery packed in crates?
9. Give the numbers of bunches of celery per crate.

Activities.—Harvest celery and calculate costs. Visit a packing house and assist in washing, grading, and packing. Time the various operations.

Harvesting Celery.—The paper, boards, and soil used for bleaching are removed from the rows. Boards and paper are saved for future use. The celery plants are cut by means of

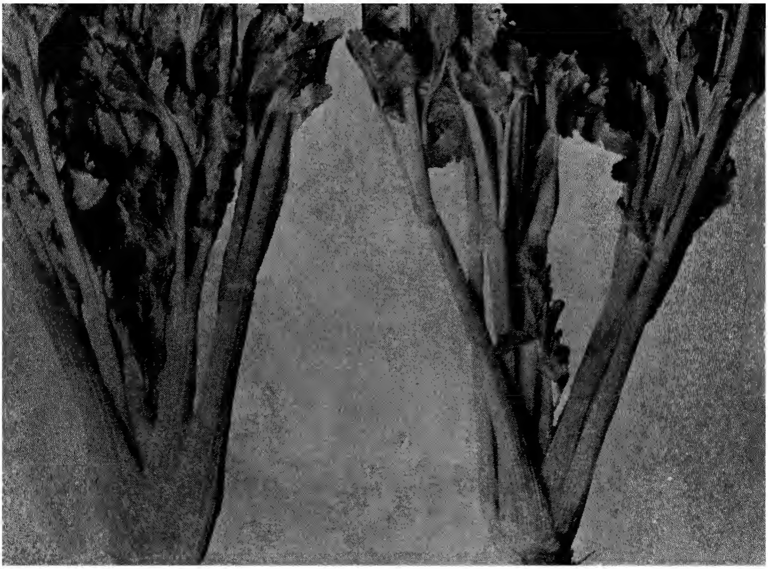


FIG. 24.—Left, grade 1, and right, grade 2 of celery stalks.

a sharp knife mounted on two wheels. The knife cuts the celery off at the surface of the ground. The trimmers come along and lift the stalks and trim off all of the outer leaves. The stalks are then placed in piles ready for grading and packing.

Grading Celery.—The official United States and Florida standards for celery provide for U. S. Fancy, No. 1 and No. 2 (Fig. 24). The sorting is also done according to size. The crew in harvesting celery usually separates or grades the stalks according to size into piles so that three, four, six, eight,

or ten dozen will fill a crate. Usually three sizes are selected.

The two grades differ in perfection of blanching, freedom from discoloration, and soundness of tissue. A fancy grade is sometimes made of celery hearts, which is usually intended for special markets.

In strict grading much imperfect celery is discarded. This aids in maintaining better prices for good celery. Imperfect, diseased, pithy, brown, and very small bunches are discarded.

Washing.—Celery is packed in the field or in special houses constructed for the purpose. At the packing house, the celery

FIG. 25.—Crate of fifty No. 1 celery plants ready for the cover.

is washed by means of a heavy spray of cold water which is forced through the bunches as they pass on an endless belt. If packed in the field, the celery is not washed. The washing of celery makes it look better and usually causes it to bring a better price.

Packing.—Crates should be lined with paper. When careful shed packing is done, the plants of uniform size and appearance are bunched together and tied with special tape, usually several plants making up a bunch. Bunches of the same grade are packed in crates together, and the number of bunches is stamped on the outside of each crate.

The Crates.—The common crates used for celery are 10 x 16 x 22 inches, inside dimensions (Fig. 25). They should be light-

weight and open, to facilitate handling and ventilation. The crates are packed in a refrigerator car for shipment. A carload of celery is counted as 350 crates.

Job 14. Marketing Celery

Conditions Usually Found.—Celery is usually shipped in car-lots and much of it is consigned to commission merchants. Coöperative packing and selling is sometimes found.

Aims.—Students should know how to market celery crops most advantageously.

Problems for Study and Discussion

1. What is the method used in your community for marketing celery?
2. What is meant by consigning a car to a commission firm?
3. From what source may a farmer receive market news service?
4. Discuss the matter of local express shipments.
5. What are the advantages of coöperative marketing?

Activities.—Obtain the rules of a coöperative packing and shipping association. If possible, compare results from two methods of selling.

When to Sell.—The celery crop in the southern region is seldom held in storage but is marketed as soon as it is ready. Prices are usually higher at that time as the northern crop is not commonly found in the markets.

Marketing is done in some localities through coöperative associations, but in most places the individual grower consigns his shipment to a commission merchant. The manager of a coöperative association locates the best markets or invites buyers who pay for the crop when the cars are loaded. Sometimes the crop is sold in the field. Returns are made to the members as soon as it is sold. Near large cities celery is often trucked to market, and is usually then sold directly to hotels, restaurants, hospitals, sanitariums, and to local dealers, such as chain stores.

Job 15. Keeping Records

Special celery records should show a number of valuable points such as the following: (1) amounts of celery rejected at grading time with causes for the same; (2) yields of fields under different treatments; (3) returns and prices from each market at different dates; and (4) special gains or losses due to certain causes. Suitable forms for the regular crop accounts are shown in the Melon Enterprise.

Celery Calculations.—1. If celery land is valued at $1,000 per acre, for what should a field of 8 acres rent to give the owner 9% interest?

2. If the price of 4-inch lateral tile is 5 cents a foot, determine the cost of materials for tiling one acre. The main is already constructed. Laterals are to be placed parallel and 20 feet apart.

3. The cost of digging, laying tile, and filling the ditch (problem 2) is 2 cents a foot. Find the labor costs and total costs.

4. How many celery plants are needed to set an acre if the rows are 3 feet apart and the plants set at 4-inch intervals?

5. What would be the cost of setting the plants on the above acre at 50 cents per thousand?

6. A young man wishes to apply 2,100 pounds of 16% nitrate of soda, costing $40 a ton, 1,600 pounds of 16% superphosphate, costing $18 a ton, and 600 pounds of 48% muriate of potash, costing $45 a ton. What will be the total cost?

7. The same young man can get a 5-5-5 fertilizer at $42 a ton and would use 3 tons instead of using that in problem 6. Which will cost the more? Find the percentage of saving.

LETTUCE ENTERPRISES

Collaborator: A. M. Musser, B.S., Associate Professor of Horticulture, Clemson College, S. C.

The use of lettuce as a food is recorded in some of man's earliest writings. The Greeks and the Romans used lettuce as a salad, and it is thought to have originated within the Mediterranean Area. This species, however, has never been found in the wild state.

Lettuce is our most important salad crop and is available at all seasons of the year since it is grown throughout the United States in home and market gardens and, in many northern areas, in greenhouses as a forcing crop.

Fertile, well-drained soils and moderately cool temperatures are important factors contributing to rapid growth, essential to high quality in lettuce.

Analysis into Jobs.—The main jobs in producing and marketing lettuce are given below.

Job 1. Determining Possibilities with Lettuce

Conditions Usually Found.—Lettuce is grown for commercial purposes in limited areas and is usually a profitable crop.

Aims.—The student should consider climate, soil, yields, cost of production, markets and prices, and other factors before deciding to grow this crop.

Problems for Study and Discussion

1. What is the acreage devoted to this crop in your community?
2. Find the average cost per acre for growing lettuce.
3. What has been the average yield in your community during the past five years?
4. What has been the average prices for lettuce during the past five years?
5. How long does it take to grow a crop of lettuce?
6. How could you secure the capital necessary to grow the crop?
7. Find out what difficulties farmers in your locality are having in growing lettuce.
8. What states compete on the market with the lettuce from your locality?

Where Lettuce is Grown.—Lettuce may be grown in home gardens in every state. In southern regions the commercial

crop is grown during the fall, winter, or spring months. The leading states in growing early lettuce as a commercial crop are given in order: California, Arizona, Florida, South Carolina, Georgia, Virginia, and North Carolina. Some lettuce is grown in practically every southern state for the winter or spring market. Large crops of lettuce come in later in the season from Colorado, New York, New Jersey, Washington, and Idaho.

Cost Per Acre for Lettuce.—The cost of producing lettuce will vary from year to year, and from one section to another; and it will also vary with the season, the amount of fertilizer used, the rent of the land, the price of labor, and other factors. The cost per acre for lettuce will probably range from $150 to $250.

Yields of lettuce vary greatly from one section to another and for different seasons. The general average for a recent five-year period was 142 crates per acre. In certain sections, the average yield during the same period was around 225 crates per acre. Yields as high as 500 crates per acre are sometimes produced. The average yield would be hard to estimate for the South, although the range would probably be from 100 to 900 crates per acre.

Prices to Expect.—For any of the truck crops prices vary from season to season. As a general rule, the prices are high during the winter and early spring months. The New York prices for lettuce during December, January, February, March, and April usually range from $2.00 to $5.00 per crate. The farm value of lettuce for the U. S. from 1934-43 per crate was $1.78, and for 1945, $2.92.

Job 2. Choosing the Varieties to Grow

Conditions Usually Found.—Farmers usually grow one standard variety in a season.

Aims.—The student should know what varieties are suitable to grow for market.

Problems for Study and Discussion

1. Make a list of the different types and the leading varieties of lettuce.
2. Report from growers which of these varieties are grown for the market.
3. What are the characteristics of a good variety for the market?
4. What would be the advantage of growing only one variety?
5. Which variety will you grow for the market?

Types of Lettuce.—There are several commonly grown kinds or types of lettuce. These are leaf lettuce, seldom grown for market, head lettuce, the type demanded in leading markets, and romaine or cos lettuce. Head lettuce should become firm, very much like the heads of cabbage. Romaine or cos lettuce is more erect than the common leaf lettuce and endures summer heat better. It is in demand in cities where there is a foreign

FIG. 26.—Big Boston variety of head lettuce is often preferred for the winter crop grown in the lower South. Note the two-row system of planting.

population, and is becoming better known by native Americans.

Types of Variety to Select.—Head lettuce, butter and crisp varieties, and romaine are the types grown in the South for commercial purposes. The leading varieties of head lettuce are Big Boston, Cream Butter, New York or Wonderful, and Iceberg. The Big Boston variety will not head well where the nights are too warm. The Big Boston (Fig. 26) has large heads and is the main variety used where the crop can be grown during the winter. It is later in maturing than the others mentioned. Most markets prefer large-headed varieties. Romaine becomes brown in certain sections.

Benefits of One Variety.—When a community grows only one variety, buyers, dealers, and markets are more easily supplied and are often better satisfied. Surplus plants are more easily bought or sold, and growers become more expert in all operations.

Job 3. Selecting the Soil and the Field

Conditions Usually Found.—Growers try to select an early soil for growing lettuce.

Aims.—How to select soil for successful growth of early lettuce should be understood.

Problems for Study and Discussion

1. On what type of soil is lettuce grown in your community?
2. Of what importance is an early soil?
3. How will lettuce grow on a low-acid soil?
4. What kind of soil would you select?

Soils for Lettuce.—The crop will grow on many different types of soil. Any soil for lettuce should be well supplied with vegetable matter and should be drained so that water will not stand on it. Soils containing a large proportion of sand or silt will become warm earlier than the heavy types. It is important that the soil be early so that the crop will be ready for the market in the shortest time. Probably the best soil for lettuce is a moist, rich, slightly acid, sandy loam that can be properly drained. It is also very important in warm climates that irrigation be provided for watering when necessary.

Choosing the Field.—Rotation of crops is less important with short season crops than with others, because other short crops can be grown in rotation each year. By this plan a green manure crop may be grown and plowed under for lettuce. If the field has been provided with an irrigation system, the lettuce crop may be rotated with celery or other truck crops requiring irrigation.

Job 4. Obtaining Seed; Testing and Treating

Conditions Usually Found.—Many growers who buy seed pay too little attention to the sources of seed, and also fail to test and treat it.

Aims.—The student should know where good seed may be obtained and how to test and treat seed.

Problems for Study and Discussion

1. From what sources do growers in your locality secure their lettuce seed?
2. How much seed is needed to produce plants for an acre?

3. When should the seed be purchased?
4. Give directions for treating lettuce seed with semesan.
5. How would you test lettuce seed for vitality?

Activity.—Make a rag-doll tester and test lettuce seed; also treat seed.

Source of Seed.—Very few growers in the southern region ever attempt to save lettuce seed at home. Each grower relies on purchasing them from some reliable seedsman. He should be careful to secure fresh seed of known high quality.

Amount of Seed to Purchase.—It is best in planting any truck crop to be certain to use enough seed to secure plenty of plants. Where the plants are grown in frames it will take from one to two pounds of seed to produce enough plants to set an acre. In some southern sections, growers practice sowing the seed in the permanent row and then thinning the plants. If this method is practiced, it will take about three pounds of seed to plant an acre.

Testing and Treating Seed.—Use the same test for vitality as suggested for testing melon seed. It is important that seed be treated with semesan before planting, as more will sprout, and seed-borne diseases will be controlled. Use a water solution containing one-fourth of one per cent semesan and soak seed for thirty minutes.

Job 5. Preparing and Managing the Plant-bed

Conditions Usually Found.—Most farmers produce their own plants. A special bed is prepared for growing the plants.

Aims.—The importance of securing good plants and how to produce them by proper management of beds should be understood.

Problems for Study and Discussion

1. What kinds of plant-beds are used for growing lettuce plants?
2. At what time of year should the seed be planted in your region?
3. How are seeds planted in the beds?
4. Give directions regarding the supplying of heat when needed in your region.
5. Outline plans for ventilation, watering, hardening-off, and transplanting the plants.
6. Why is transplanting important for head lettuce?

Activities.—Construct a hotbed or cold-frame, then plant and care for it.

Kind of Plant-bed.—Lettuce plants may be grown in the greenhouse or in a hotbed, but the more common practice in warm regions is to produce them in cold-frames. Often a bed

is prepared out in the open and protected from the sun and wind by a cloth cover. Some growers drill the lettuce seed thick in the field rows and use the extra plants, when thinning the rows, to set additional acreage. The transplanted plants more often produce better heads.

Planting the Seed.—It usually takes from six to eight weeks from the time of sowing the seed until the plants are ready to set in the field. The seed is sown by hand when being sown in the plant-bed and covered about one-fourth of an inch deep. The plant-bed is usually marked off in rows about four inches apart and the seed sown in the rows. The best growers transplant the plants of head lettuce once in the beds. Transplanting to the bed gives better plants and is said to result in better heading.

Job 6. Preparing the Field for the Plants

Conditions Usually Found.—Soil for lettuce is usually well prepared.

Aims.—The importance of a well-prepared soil and the tools needed for the preparation should be understood.

Problems for Study and Discussion

1. Which would you recommend, fall or spring plowing? Why?
2. What are the advantages of deep preparation?
3. How much time should there be between plowing and planting times?
4. Why should the soil be harrowed several times during this period?
5. How far apart would you space the rows for lettuce?
6. How are rows marked off?

Preparing the Soil.—Lettuce plants are set in the field during the winter or early spring months, hence early fall preparation of the soil is usually necessary. The soil is turned to a depth of six to eight inches with a good turning plow. All trash must be turned under deep enough so that no trouble will be given in cultivation. The soil should be harrowed several times at intervals of a week or so. This will help in controlling weeds and insects, will make a fine seed-bed, and will warm the soil by aeration. The field is usually laid off in check rows about sixteen by sixteen inches, using hand or horse markers. In some sections lettuce is planted with more space after the fourth row and every multiple of four rows. This gives the effect of four-row beds.

Job 7. Setting the Plants in the Field

Conditions Usually Found.—Lettuce plants are set by hand.

Aims.—How to set lettuce plants rapidly and successfully should be understood.

Problems for Study and Discussion

1. How are the plants pulled from the plant-bed?
2. How large should the plants be when they are set in the field?
3. How many plants are needed for an acre?
4. Describe a good method of setting lettuce plants by hand.
5. Calculate the cost of setting an acre of lettuce.

Activities.—Practice setting lettuce plants and calculate the time and expense, and find the percentage that live.

Pulling Plants.—Special care must be taken in pulling lettuce plants from the bed because they are easily injured. It is usually a good practice to soak the bed so that plants can be removed without serious damage being done to the roots.

Setting the Plants.—Lettuce plants are ready to set when the leaves are three to four inches long. As the plants are rather tender, few growers try to set them by machinery, the usual method being to set plants by hand. Care must be taken not to mash the buds, and to see that the plants are not set so deep as to permit the soil to cover them when heavy rains follow the planting. If the weather is dry, it is necessary to put about a pint of water to each plant, or to irrigate the field soon after setting. Care must also be taken to press the soil around the roots.

The number of lettuce plants needed to set an acre depends upon the distances between the rows and the distances between plants in the row. On an average, 25,000 to 30,000 plants are set on an acre. Late afternoon is the best time to set plants. (Fig. 27.)

In preparation for the planting, the field is marked off in checks sixteen by sixteen inches. The plan of setting several rows on a bed with a deep furrow between beds is believed to cause the soil to warm up earlier than where level planting is used. (Fig. 28.)

A number of workers form the planting crew. One person drops the plants at the intersections, and the others, working on their knees, set them. A planting crew is able to set from 2,000 to 4,000 plants in a day, and is often paid at a given rate per thousand plants.

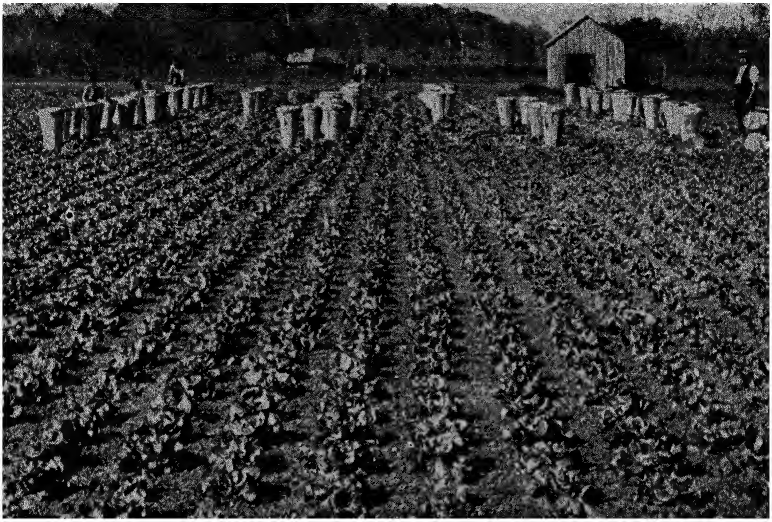


FIG. 27.—Setting a lettuce project in successive areas distributes labor at setting time and also at harvest time. The area shown by the field hampers was set a few days ahead of the other area. (Seaboard A. L. Ry.)

FIG. 28.—Two-row system of setting head lettuce on farm of J. P. Herring, New Hanover Co., N. C. (Atlantic Coast Line Ry.)

Job 8. Providing Plant Food; Applying Fertilizers

Conditions Usually Found.—Growers usually buy ready-mixed fertilizers for lettuce.

Aims.—The food requirements of lettuce and what fertilizers to use should be understood.

Problems for Study and Discussion

1. Find the kinds of fertilizers being used in your community for lettuce.
2. At what rates are the fertilizers applied?
3. How many applications of fertilizer are made?
4. Discuss the advisability of using barnyard manure for lettuce.
5. Under what conditions may the home-mixing of fertilizers be profitable?
6. Be able to figure the materials needed for an early-lettuce fertilizer analyzing 5-8-5 (N-P-K).
7. When should side applications of quickly available nitrogen be used? Why?

Fertilizers for Lettuce.—Growers have to fertilize lettuce rather liberally, depending upon the type of soil. Barnyard manure applied at the rate of five to ten tons per acre is a very good fertilizer, but should be supplemented with commercial fertilizers. The mixtures of commercial fertilizers used by growers vary on different soils. Some growers use a 5-5-5 while others use a 5-8-5 (N-P-K). The fertilizer is applied at the rate of one to two and a half tons per acre. Usually this main mixture is applied in two applications, the first one being made before the plants are set, and the second one, two or three weeks after the plants are set. In some cases additional side dressing of 200 pounds of nitrate of soda or sulfate of ammonia is used.

Supplementing Organic Manures.—When barnyard manure is used, little if any nitrogen is needed. Growers should then buy only the needed ingredients and mix them or apply them separately. Many extensive growers find it better to buy and mix fertilizers themselves. (Fig. 29.)

Job 9. Cultivating the Crop

Conditions Usually Found.—Growers practice frequent shallow cultivation for lettuce.

Aims.—Reasons for cultivation and how to cultivate lettuce successfully and economically should be understood.

Problems for Study and Discussion

1. What implements are needed for cultivating lettuce set in narrow rows?
2. At what time of the day is it best to cultivate?

3. What are the main reasons for cultivating lettuce?
4. How often should lettuce be cultivated?
5. Discuss shallow vs. deep cultivation.

Activities.—Compare results of growing lettuce in shade and in open places.

Cultivating Lettuce.—It is best to cultivate lettuce after the dew has dried in the morning or during the afternoon. The young plants cannot compete with the weeds; therefore frequent, shallow cultivation is necessary. Lettuce roots grow near the surface of the soil, which makes it important that all cultivation be shallow. Horse cultivation can be given if the rows are far enough apart. This makes the work a little lighter but not more rapid. Most growers cultivate lettuce with hand

FIG. 29.—Heavy fertilizing has brought heavy growth of head lettuce for this student in his project near Wilmington, N. C.

wheel hoes. Common hoes, rakes, and weeders are also used for this purpose.

Shading lettuce makes it head better than when exposed to the hot sun. Growers sometimes secure partial shade from the afternoon sun by planting east of a row of large trees, and then cutting the roots of the trees by digging a trench east of the tree trunks. Cloth shade is sometimes provided for large areas (Fig. 30).

Job 10. Controlling Diseases and Insects

Conditions Usually Found.—Growers have to control several different diseases and a few insects.

Aims.—Knowing the diseases, insects, and their effects, and how to control enemies, are all necessary for success.

Problems for Study and Discussion

1. Make a list of the diseases of lettuce found in your community.
2. Identify each of these diseases.
3. How may each of these diseases be controlled?

4. What insects injure lettuce? How are they controlled?
5. What would be the cost of spraying an acre of lettuce?
6. Under what conditions would you dust and not spray?

The drop disease attacks the plants, causing a soft rot and making them droop. A white fungus may be found on the under side of the leaves, later turning black. These black bodies may be found in any of the decayed parts of the plant. The disease often causes considerable damage. No practical control meas-

FIG. 30.—Iceberg head lettuce growing under cheesecloth cover supported by posts and wires. Irrigation water is conducted through five-inch galvanized iron pipe.

ure has been found, but it is suggested that all diseased plants be removed just as soon as they are detected.

Mosaic attacks several other of the truck crops. The disease may be transmitted by plant lice. The best control measure is to keep the plants free from all kinds of plant lice by spraying them with nicotine sulfate.

Tip-burn is caused by unfavorable growing conditions, high humidity, and high temperature. The disease is much worse during hot weather. Irrigation to cause continuous, even growth should help. Early harvesting is practiced if the trouble starts.

Bottom-rot attacks the plants at any stage, but usually does the most damage to young plants. The entire head may rot or just the leaves which come in contact with the soil. The best

control measure is proper drainage of the soil and thorough cultivation.

Anthracnose appears on the leaves as water-soaked areas which later turn brown. These brown spots drop out, leaving the leaves with small holes in them. The proper rotation of crops is probably the best control measure.

Lettuce Insects.—Very few insects damage the lettuce crop. The most important are the plant lice. These may be controlled by spraying with nicotine sulfate.

In some places, the cutworms do some damage just after the young plants are set. These may be held in check by means of poison mash (see Appendix), and by bare-fallow methods before planting.

Job 11. Harvesting, Grading, and Packing

Conditions Usually Found.—Too few growers grade lettuce; some do not pack it to suit best markets.

Aims.—Students should know how to harvest, grade, and pack lettuce to secure best prices.

Problems for Study and Discussion

1. How can you tell when lettuce is ready to harvest?
2. How is lettuce cut when being harvested?
3. Why should lettuce be placed in the shade as soon as harvested?
4. Into what grades is lettuce sorted?
5. What kinds of packages are used for shipping lettuce?
6. How should lettuce be packed when filling crates?
7. What are the advantages and methods of pre-cooling lettuce when shipping?
8. Describe the proper method of loading cars.

Activities.—Practice harvesting, grading, and packing lettuce. Assist in loading and shipping the crop.

Harvesting Lettuce.—Head lettuce is harvested as soon as the heads become firm. The cutter goes down each row and selects the heads which are ready, and cuts each head off, with a sharp knife, just above the two bottom leaves. The other heads are cut at a later period. Leaf lettuce is harvested at any time after the plants are large enough.

Grading Lettuce.—Grading is important, but in actual practice eastern growers seldom grade lettuce, except what grading is done by the cutter in selecting the heads in the field. (Fig. 31.) It would doubtless pay to grade the heads into at least two grades. The U. S. Dept. of Agriculture has recommended three grades: Fancy, No. 1, and No. 2.

"*U. S. Fancy* shall consist of sound heads of lettuce of similar varietal characteristics which are fresh, neatly trimmed, and firm; which are not wilted, decayed, burst, or showing seed stems or doubles, and which are free from damage caused by freezing, tip-burn, disease, insects, or mechanical or other means. Each head of lettuce shall weigh not less than one pound. In order to allow for variations incident to commercial grading and handling, 5 per cent, by weight, of any lot may be below the prescribed weight and, in addition, 4 per cent, by weight, of any lot may be below the remaining requirements of this grade."

"*U. S. No. 1* shall consist of sound heads of lettuce of similar varietal characteristics which are fresh, partially trimmed, and reasonably firm;

FIG. 31.—Packing of head lettuce chiefly done in the field. Hampers 1½-bushel size. (Seaboard A. L. Ry.)

which are not wilted, decayed, burst, or showing seed stems or doubles, and which are practically free from damage caused by freezing, tip-burn, disease, insects, or mechanical or other means. Each head of lettuce shall weigh not less than ¾ of a pound."

"*U. S. No. 2* shall consist of heads of lettuce which do not meet the requirements of U. S. No. 1."

Packing Lettuce.—The most common package for shipping lettuce from North Carolina, South Carolina, and Florida, is the 40 to 48 quart hamper (Fig. 32). Some sections use crates. In packing the heads the first layer in the hamper is placed with the stem end down; the top layer is reversed. A hamper carries about 25 heads of first quality lettuce.

Job 12. Marketing Lettuce

Conditions Usually Found.—Lettuce is shipped in car-lots or express shipments and is usually consigned to commission merchants.

Aims.—The functions of marketing and how to market lettuce should be understood.

Problems for Study and Discussion

1. How do local growers market lettuce?
2. What is meant by consigning a car?
3. What use is made of the market news service?
4. What advantages are to be expected from coöperative marketing?
5. Discuss the matter of local express shipments.

Activities.—Visit a shipping point where lettuce is being marketed and study marketing methods.

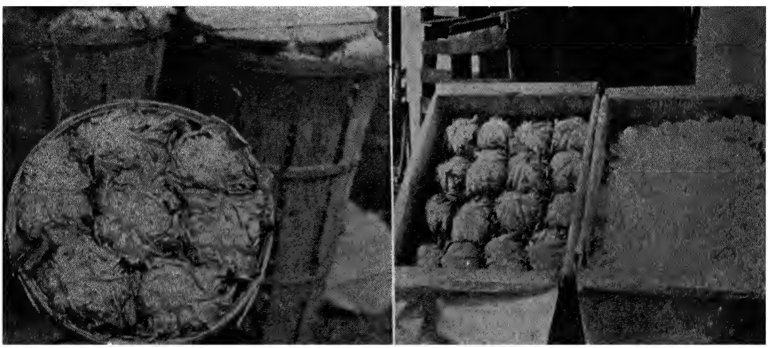


FIG. 32.—Left, face of hamper showing seven heads of lettuce, a fancy pack. Right, crates line with oiled paper, packed, and head lettuce covered with chipped ice for shipment by express.

Marketing Lettuce.—The crop is marketed just as soon as the shipment can reach the market. The product should reach the market in as fresh condition as possible. It is commonly shipped in refrigerator cars (Fig. 33). In show windows lettuce should be fresh and crisp.

Locating Markets.—Shippers must be very careful to secure suitable markets for lettuce. There is much danger of overstocking at certain seasons of the year, but city markets will consume large quantities of lettuce if it is put before the buyers in an attractive form.

Coöperative Shipments.—In some sections shipments are made coöperatively. One of the chief advantages of this plan is the finding of suitable markets which are not glutted or inclined

to be overstocked. The manager may need to telegraph or telephone to a number of places before making shipments. He can do more of this than individual shippers could afford.

Consignments.—When the crop is shipped on consignment the commission man receiving it is required to sell the crop in that market regardless of market conditions. If it does not sell

FIG. 33.—Hampers of head lettuce packed in refrigerator car, as shown through the side doorway.

well the commission merchant can hardly be blamed. While this is the easiest way of selling, it is likely to be the poorest way.

Job 13. Keeping Records

Record forms are given in the Melon Enterprise. Use similar forms or get others for keeping the cost records, sales records, and summary record of the Lettuce Enterprise.

Additional records should show yields, losses from various causes, comparisons of different markets and methods of marketing, percentages of culls at packing time, and other important features.

Lettuce Calculations.—1. A young man finds that his total cost of growing lettuce to the time of harvest is $185 per acre. If the cost of the hampers and of harvesting is 45 cents each, freight charges 60 cents each, and the commission for selling 5%, find his net profit after selling his crop in New York as follows: 95 hampers at $3.15; 83 hampers at $2.75; 116 hampers at $2.25; 123 hampers at $1.50.

2. If a grower pays 50 cents per thousand for setting lettuce plants, what will be the cost to set an acre if the plants are set in 16-inch checks?

3. A student needs to borrow $140 to finance his project. His uncle offers him the money for $5.00 interest for 6 months. If he can borrow it from the bank at 8 per cent annual interest, at which place should he borrow it?

4. If the local price of woven wire fencing is $1.00 a rod, determine the cost of wire for fencing 5 acres of lettuce land in the shape of a right triangle, the two perpendicular sides being 40 rods each.

5. Posts for the rabbit fence in problem 4 are set 1 rod apart and cost 15 cents each. What is the total cost for posts if $1.00 each is allowed for the three corner posts and braces?

6. The labor of driving the posts is 3 cents each; the stretching and stapling, including the staples, costs 5 cents a rod. What is the cost of labor?

7. Find the total cost of fencing the field from problems 4, 5, 6.

8. At the costs and returns in problem 1, what will need to be the percentage of saving of net profits on the 5-acre field, if one-sixth of the cost of fencing is charged each year?

ENTERPRISES WITH SPINACH AND OTHER GREENS

Collaborator: H. H. Zimmerley, Ph.D., Director, Truck Station, Norfolk, Va.

Spinach is thought to be native to southwestern Asia. Kale, collards, broccoli, turnips, and mustard are all related crops, members of the mustard family. Of this group of so-called "greens," spinach is the most important commercially. It is the most widely grown of these crops, being quite generally produced in home gardens and for market throughout the United States. Spinach is important, also, as a crop for processing. Kale, collards, and turnips for greens are more frequently grown in the southern states than in other areas. The collard is a form of kale.

Analysis into Jobs.—In this enterprise are included spinach, New Zealand spinach, chard, kale, collards, mustard, turnip greens, and green-sprouting broccoli. The following list of units includes the main operative and managerial jobs of any one of these enterprises.

Job 1. Determining the Possibilities with these Crops

Conditions Usually Found.—Spinach and other greens are often grown for both home and commercial use.

Aims.—The various factors which determine whether or not these crops can be successfully grown and handled should be understood.

Problems for Study and Discussion

1. Make local inquiries to determine how extensively greens are grown in your section.
2. List the various kinds of greens, and those grown in your section.
3. What greens are of greatest commercial value?
4. How do these crops rank with other vegetables as to (a) labor requirements; (b) cost; and (c) returns?
5. Why is the use of greens increasing in the daily diet?
6. Determine by a market study the months during which greens are in greatest demand.
7. What main factors are responsible for greens not being more extensively grown for commercial shipment?
8. What crops combine best with the growing of greens?

Kinds and Popularity.—To this group belong spinach, New Zealand spinach, chard, kale, collards, mustard, tendergreen, and turnip greens. Dandelions also belong to this group, but are little used in southern states, except from wild cuttings. Tendergreen is one of the new greens sometimes called "mustard spinach." Spinach is the most important commercial crop in this group. Turnip greens are of increasing importance as a local crop and as a canning crop.

Where Grown.—Greens are grown rather generally throughout the United States, many states having one form or another in the wild state. They are used as spring and fall crops in the North and cooler regions, and mainly as winter and early spring crops in the South. True spinach, mustard, and turnip greens are adapted to cool weather only. The other crops of the group endure both heat and cold.

Spinach is grown commercially for use as a fresh vegetable in nearly every southern state. Maryland, Missouri, Texas, Virginia, North Carolina, South Carolina, Arkansas, and Louisiana grow 75 per cent of the total acreage of spinach in the United States, or 45,000 to 50,000 acres annually yielding 9 to 10 millions bushels. California and Maryland grow large quantities of spinach for canneries. Fresh spinach is shipped in carlots from Missouri, Maryland, South Carolina, Virginia, and Texas. The last two are the heaviest producers.

The prices received range, by state averages, between 70 cents and $1.10 per bushel. Canneries paid $30 to $35 per ton in California, and about $70 per ton in Maryland in 1945.

Requirements, Costs, and Returns.—All the plants in this group are easily grown. They require little hand labor except for thinning, harvesting, and preparing for market.

To be crisp and of good quality, spinach, mustard, and turnip greens must grow rapidly and during cool weather. Their growing season is short. Less time is required for returns from greens than from many other vegetable crops: Spinach, 40 to 90 days; mustard and turnip greens, 50 to 80 days; collards, chard, New Zealand spinach, and kale, 50 to 100 days.

The cost of production of these crops, with the possible exception of spinach, is comparatively low. It is usually estimated that seed, fertilizer, and labor will represent about half the cost of growing and marketing.

Factors Affecting these Crops.—Greens have increased in popularity and use during recent years, due mainly to the discovery of their vitamin content and due to the minerals which they are thought to supply to the human body. Crops of this group are usually considered as cheap and bulky. They require much more land area per dollar returned than do other crops of the same package cost. Low-priced seed, quick returns, and usually no transplanting favor the growing of these crops.

Winter and early spring crops of greens combine well with the growing of summer crops. The short time that early greens occupy the ground make possible the use of the same fields at other seasons.

Fig. 34.—At harvest time many hands and a large supply of barrels are required for moving the spinach crop. View, Nansemond Co., Va. Cotton follows spinach. (Atlantic Coast Line Ry.)

Job 2. Choosing the Crop and its Varieties

Conditions Usually Found.—Kinds and varieties are usually selected in keeping with local conditions of growth and with market requirements.

Aims.—The different kinds and varieties should be considered, and those selected which will meet local conditions and marketing requirements.

Problems for Study and Discussion

1. Which crops of greens require cool weather only?
2. Which crops of greens will endure both heat and cold?
3. What factors should be taken into consideration in selecting the crop of greens to grow?
4. Name the leading variety of each crop of greens in your section.
5. Make a list of the best varieties of each of these crops.
6. Why is it best to select tried and known varieties?
7. Give the outstanding characteristics of the leading varieties.

Activities.—Contrast results from growing spinach as compared with mustard or turnip greens.

Choosing the Crop to Grow.—For home use and for local markets, the crops best adapted to the soil and climate, and those meeting the requirements of the home and local market should be selected. In choosing crops for shipment to distant markets, the demand of the particular markets should be considered.

Spinach usually sells better in northern markets. Mustard and turnip greens sell best in southern markets. Kale is often popular in both sections. New Zealand spinach, chard, and collards are well adapted to home gardens and are seldom extensively grown for market or for canning.

Fig. 35

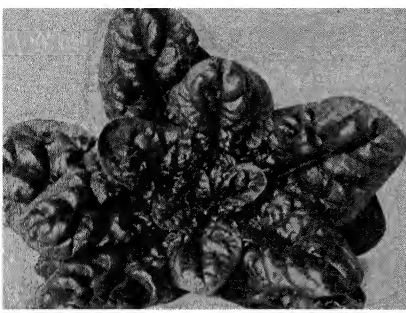


Fig. 36

Fig. 35.—Savoy spinach showing healthy growth. (T. W. Wood and Sons, Richmond, Va.)

Fig. 36.—Giant Southern Curled mustard in prime condition.

Varieties of known value and of standard marketable quality known to be well adapted to the section in which the planting is contemplated should be selected.

By selecting a tried and known variety, the grower is less likely to have trouble in marketing, and is not confronted with the problem of experimenting and experiencing possible losses. Leading varieties are listed:

Spinach: Virginia Savoy (Fig. 35), Bloomsdale.
Mustard: Giant Southern Curled (Fig. 36), Chinese Broad-leaved, Fordhook Fancy.
New Zealand Spinach: New Zealand.
Chard: Lucullus.
Turnip: Seven-top.
Kale: Siberian, Dwarf Blue Scotch, Green Curled Scotch.
Collard: Georgia or Southern.

Job 3. Selecting the Soil and Field; Planning Rotations

Conditions Usually Found.—The soil for these crops, other than spinach, is usually not carefully selected, due to the fact that they are generally used as companion crops.

Aims.—The types of soil required by these crops; how to locate plantings to the best advantage; and how to plan rotations should be understood.

Problems for Study and Discussion

1. What types of soil do these crops prefer?
2. Give differences in soil requirements of these crops.
3. What factors would you consider in selecting a location for these crops?
4. What type of crop should precede these crops?
5. Describe a good rotation for the early spring greens.
6. Give a good rotation plan for crops of greens grown in summer for local or home use.
7. Give the kind of soil used by commercial growers in your community.

Activities.—Compare results of the crops of greens following two different field crops.

Type of Soil.—Spinach thrives best on a well-drained, sandy loam or clay loam soil, although, in some sections of the North, it is very successfully grown on muck soil. Spinach will not thrive on highly acid soils. Add lime to bring the soil almost to the neutral point. Too much liming should be avoided because the spinach plants may become yellow if the soil is alkali. The other early greens require practically the same type of soil as spinach. Since they are rapid growers, they should be planted in good rich soil that contains plenty of humus. Collards and kale will endure heavier applications of unrotted organic matter in the soil as they are "coarse feeders" like cabbage and corn.

Location of Field.—The field should be reasonably level. If possible, the field should be near a road and near the packing shed. Extra hauling or handling decreases quality, and increases cost of production.

Previous crops might be either clean-cultivated crops or heavy green manure crops. Regardless of the kind of previous crop, this should be turned sufficiently long in advance of planting any of the greens to permit the settling of the soil. Weeds and grass should not be permitted to re-seed on fields where these crops are to be planted. Low quality will result from crowding by weeds, and harvesting is more difficult.

Rotations.—Early spring greens may be followed the same year with corn, melons, or beans. After early sweet corn or

beans, a green manure crop may be grown and turned under before the sowing of early spring greens. Summer crops of greens, as chard and collards, may be grown in rotation with potatoes, followed with green manure crops.

Job 4. Obtaining Seed; Testing and Treating

Conditions Usually Found.—Experienced growers usually buy seed from reliable seedsmen and dealers rather than save seed at home.

Aims.—The importance and methods of obtaining good seed and of testing and treating seed should be understood.

Problems for Study and Discussion

1. What farmers in your community generally save seeds of these crops?
2. What is the main assurance of good seed?
3. What is meant by "run-out" seed?
4. Describe the rag-doll method of testing seed.
5. Why are seeds treated? Describe the treatment.
6. What are the main disadvantages of buying packet seeds?
7. In your section what are the sources of seed supply?
8. Make a list of seed houses or dealers that might supply good seed in your section.

Activities.—Practice testing and treating seeds of these crops.

Home-grown Seed.—With certain vegetables, such as collards and turnips, home-grown seed, if properly handled, may be saved to an advantage. The prevalence of diseases and unfavorable climatic conditions are largely responsible for the condition commonly known as "run-out" seed, occurring when seed is saved and planted over and over again. This may result in the crop being later and of a poorer quality.

Seed Houses.—Reliable seed houses should be selected. Certified seed is sometimes available. Up-to-date seed houses and dealers usually are willing to supply information as to the source of the seed and percentage of germination.

Testing Seeds.—The rag-doll method gives the truest results for testing seeds. The method is described in the Melon Enterprise. Testing under controlled conditions will not always represent what the seed will do under field conditions. The vitality might be so low as to cause seed to sprout only under the very best conditions.

Treatment of Seeds.—Organic mercury compounds, such as semesan, have been shown to be of value in reducing certain seed-borne diseases. Crops planted in cold soils usually germinate better if treated before planting. Use the recommended strength

of semesan solution, and treat seeds for the stated number of minutes. The cost is very slight.

The quantity of seed used, and the ability of the grower to buy at wholesale, according to his anticipated needs, will largely determine the price he has to pay for seed. Quality should always be the deciding factor in buying seeds. Poor seeds are always the most expensive in the end.

Packet seeds are more expensive and have in many instances been found to be lower in germination than loose seeds. For the back-yard gardener who buys seed locally, packet seed probably offers greater assurance of obtaining seeds true to name. The following are the acre-planting rates for commercial fields: Spinach, 12 to 25 pounds; turnips, $1\frac{1}{2}$ to 3 pounds; mustard, 5 to 6 pounds; kale, 4 to 6 pounds; collards, 6 to 8 ounces for 8,000 to 10,000 plants.

Job 5. Providing Plant Food; Applying Fertilizers

Conditions Usually Found.—Growers usually apply heavy applications of fertilizer and barnyard manure. Many use green manure.

Aims.—Fertilizer requirements of these crops and economical methods of supplying plant food should be understood.

Problems for Study and Discussion

1. What are the fertilizer requirements of these crops?
2. Why do some commercial growers use commercial fertilizers rather than barnyard manure?
3. What are the advantages of barnyard manure and green manure?
4. What determines the quantity of fertilizer used?
5. Explain three methods of buying fertilizer. Which do you consider best? Why?
6. What kinds of fertilizers are best, and how much should be applied per acre?
7. How much nitrate of soda or sulfate of ammonia is usually used?
8. Determine the fertilizer practices in your community.
9. How many farmers in your community mix fertilizers at home?

Activities.—Conduct a test to determine the effects of different rates of fertilizing for one of these crops.

Organic Matter.—To be of best quality, early greens must make rapid growth. Therefore some fertilizer must be applied that contains quickly available plant food. Such fertilizing is more economical if there is plenty of organic matter in the soil. Such organic matter can be easily supplied by turning under a legume crop grown for green manure. (See Job 3.) Organic matter may be applied also by using well-rotted manure or by

using fresh manure applied to some preceding crop. Avoid introducing weeds when using manure.

Nitrogen is often the limiting element of plant food in the growth and development of crops of greens. Nitrate of soda and sulfate of ammonia may be applied to advantage, causing abundant leaf growth of these crops after growth has started.

Job 6. Preparing the Soil for Planting

Conditions Usually Found.—As a rule, most farmers prepare the soil fairly well. Successful growers usually keep the soil in a very high state of cultivation.

Aims.—Economical methods of soil preparation should be well understood.

Problems for Study and Discussion

1. Why should soil be well prepared?
2. When should the soil be plowed for these crops?
3. What is the danger of plowing just before planting the crop?
4. What harrowing is advisable after plowing?
5. Give the operations in the preparation of a seed-bed for greens following oat stubble.

Activities.—Compare the practices of two growers in preparing soil in your section.

A Bare-fallow Period.—The soil should be plowed a few weeks before time for planting the crops. During the time between plowing and planting, the soil should be harrowed several times at intervals of about one week. This kills weed seeds and insects, warms soil, and prepares a good seed-bed. Soil should be plowed sufficiently early to allow time for decay of coarse vegetation. Collards are often transplanted and the soil may be prepared later than for the earlier greens.

Seed-beds.—A well-prepared and settled seed-bed is necessary for best results, because of the size of the seeds and character of growth. Some growers ridge the rows for winter or very early spring planting when the soil is likely to be too wet for thrifty growth. Ridging aids drainage. Plants growing on the south side of ridges during the winter are exposed to the sun and protected from cold wind.

The truckers in the Norfolk section and in some other sections plant spinach on beds elevated a few inches above the level of the field. This facilitates thinning and harvesting, and affords good drainage. Four rows are generally planted on each five-foot bed.

A complete fertilizer analyzing 5 to 10 per cent nitrogen, 6 to 8 per cent phosphoric acid, and 2 to 5 per cent potash should give good results. This may be made from nitrate of soda, sulfate of ammonia, blood-and-bone tankage, cottonseed meal, superphosphate, and muriate of potash. The Virginia Station proved the value of heavy applications of nitrate of soda and using ten tons of manure per acre.

Job 7. Planting the Crops

Conditions Usually Found.—When these crops are sown broadcast the soil is usually level. Slight ridging is sometimes practiced for collards, chard, or others when grown in rows.

Aims.—The best methods of economically planting crops of greens should be understood.

Problems for Study and Discussion

1. What constitutes a good seed-bed?
2. When may greens be planted?
3. Why should the seed-bed be settled, rolled, or packed?
4. How may seeds be covered? Give depth.
5. What crops of greens are sometimes transplanted?
6. Which crops may be sown broadcast?

Activities.—Broadcasting and drilling in rows should be compared.

Planting Time.—Seeds may be planted during fall, winter, or spring, depending upon the locality. In the warmer sections, successive plantings may be made so as to give a constant supply of greens. Spinach and chard germinate slowly, and time should be allowed for the slow growth of all crops of greens in cold weather. Soaking seeds aids germination.

Methods of Planting.—Both mechanical and hand-seeding methods are used. Less seed is required and more uniform stands result when seed is drilled with a planter. These crops should be planted shallow.

For winter and early spring growth spinach, kale, mustard, and turnips are frequently sown broadcast by hand and the soil is then harrowed or rolled with a rough roller such as a cultipacker. Crops may be found to make more rapid growth when grown in rows for cultivation. Chard, collards, and New Zealand spinach, if intended for use during the warm season, are commonly grown in rows widely enough separated to allow for cultivation between them. Collards and New Zealand spinach are given more spacing than chard. These three crops are

sometimes transplanted from seed-beds when the plants are very small. Machine transplanters or hand methods may be used. The plants are set at distances of about two feet. Chard may be set much closer.

Job 8. Cultivating the Crops

Conditions Usually Found.—Growers give clean cultivation when crops are grown in rows. Those sown broadcast are not cultivated.

Aims.—The most practical and economical methods of cultivation should be understood.

Problems for Study and Discussion

1. What methods of cultivating these crops are used by farmers in your community?
2. How early may cultivation of rows begin?
3. How often should cultivation be given?
4. Why can growers not use a spike-tooth harrow over these crops?
5. Describe the best implements for cultivation between rows.

Activities.—Compare results when the same crops are grown in cultivated rows and when sown broadcast. Study the effects of harrowing kale, mustard, and seven-top turnips sown broadcast.

Methods of Cultivation.—Clean, shallow cultivation is given these crops when grown in rows. Either hand cultivators or horse-drawn implements may be used. Little hand hoeing should be needed. For such crops as collards, chard, and New Zealand spinach, grown through long seasons, enough hand work should be given to keep the rows free from weeds.

Frequency of Cultivation.—Begin tillage early to stimulate growth from the very first. Cultivation should be given as often as necessary to keep down weeds, and is beneficial if given following every rain. Frequent tillage pays. Give the crop every advantage possible. Crops sown broadcast for early winter and spring cutting usually need no cultivation.

Job 9. Controlling Insects and Diseases

Conditions Usually Found.—Pests are usually well controlled by commercial growers. Plant lice and leaf-eating worms give most trouble. Spinach is often attacked by serious diseases.

Aims.—Diseases and insect enemies of these crops should be known and economical methods of control should be understood.

Problems for Study and Discussion

1. What diseases and insects of these crops are most common in your community?

2. What is the most serious disease of spinach and chard? Give control.
3. What is the damage due to leaf-miner insects? Give control.
4. Describe attacks of plant lice. Give control.
5. Describe the work of webworms and of cabbage worms. Give control measures.
6. What crops are attacked by harlequin bugs? Give control measures.

Activities.—Collect specimens of insect work and effects of disease. Participate in controlling insects and diseases.

Blight or Mosaic Disease.—Spinach and chard are often attacked by this disease. When attacked, the plants show a slight yellowish and deformed growth of young leaves. Later, the plants stop growing, and the leaves are mottled and may turn brown and wither. The leaves may be brittle and curve backward toward the base of the plant. This disease is carried to healthy plants by insects, mainly plant lice. For spinach, the best method of control is to grow blight-resistant strains such as the Virginia Savoy. Seed from individual plants not attacked by blight should be used for future planting.

Leaf-miner Insects.—These insects work between the upper and lower layers of the leaves of spinach, chard, and other members of the beet family. The insects cannot be reached by dusting or spraying. The presence of these insects is indicated by blistered leaves. Sanitary and clean-up measures are practiced methods of control. (See Root-crop Enterprise.)

Aphids or Lice.—These pests suck the juice from the leaves and carry blight disease from plant to plant. All crops of greens are subject to the attacks of plant lice. Spraying does not give entire control because the insects are abundant on the under side of the leaves. However, dusting with hydrated lime containing 3% nicotine is helpful if applied early. When possible, dust when the air is warm and calm. Twenty to forty pounds of dust are required per acre. Some varieties of spinach are more subject to attacks of aphids than others.

Cabbage Worms.—These are foliage-eating insects that are very common to crops of this group other than spinach. Spray or dust with arsenate of lead or calcium arsenate. (See Cabbage Enterprise, and "Webworms" in Root-crop Enterprise.)

Harlequin Bugs.—These are sucking and blistering insects that are very harmful to collards, mustard, and kale. (See Cabbage Enterprise.)

Job 10. Harvesting, Preparing, and Packing

Conditions Usually Found.—Careless methods of harvesting and packing are too frequently found.

Aims.—Growers should understand the essential methods of harvesting, preparing, and packing these crops.

Problems for Study and Discussion

1. What methods are used in harvesting and handling these crops in your section?
2. When are these crops ready for harvesting?
3. Explain the methods of harvesting crops of greens.
4. What types of packages are used?
5. Explain the best methods of packing these crops.
6. What difference is made in packing spinach for local and for distant shipments?
7. What is the advantage or disadvantage of washing greens? Describe methods.

Activities.—Practice harvesting, preparing, and packing different types of greens.

Harvesting.—These crops are usually harvested immediately before marketing and are handled in such way as to have them reach the market in the freshest and best possible condition.

For home use, the leaves may be picked from the time the plants have five or six leaves. Several cuttings are commonly made, the larger plants being cut first. If the plants are tender, medium or large plants are preferred. Spinach, kale, mustard, and young turnip tops are harvested by cutting the tap root just below the lower leaves. Older turnip greens are usually sold with the root, thus furnishing two vegetables instead of one. Chard, New Zealand spinach, and collard are often harvested by cutting or pulling off the outer leaves, and frequent cuttings are made.

Packing Greens.—After cutting, greens are trimmed and washed, if necessary, to free them from all grit. Washing is a better practice for greens for local or neighboring markets than for those to be shipped. They are then packed in bushel baskets, barrels (Fig. 37), hampers, or crates. For shipment, the containers are often iced. Some growers pack ice in the center, and some in the center and on top. Containers are covered with light wooden tops. Spinach shipped in barrels is often covered with burlap (Fig. 37).

Job 11. Marketing

Conditions Usually Found.—Spinach is extensively shipped or sold to canneries. The crops of greens are more commonly grown for and sold in neighboring markets, but all are sometimes shipped and sometimes canned.

Aims.—Growers should understand the different methods of marketing and know how to adapt the various crops of this group to market demands.

Problems for Study and Discussion

1. Determine by local inquiry how these crops are marketed in your community.
2. Find from growers and from dealers the prices received by growers, and those paid by consumers.
3. Talk with dealers and calculate the percentage of loss after packing.

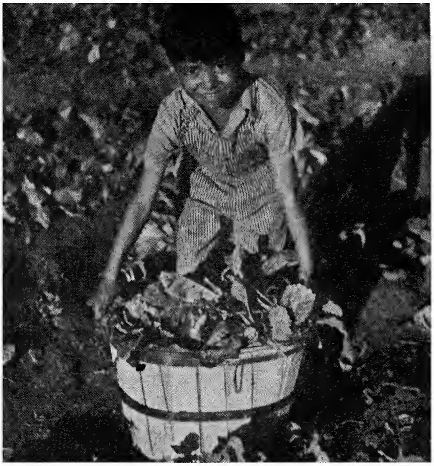


FIG. 37.—Harvesting spinach. The bushel basket is a favorite package for spinach and other greens. (Farm Security Administration. Photo by Rothstein.)

4. What are the advantages of shipping in large quantities?
5. What is meant by an f.o.b. sale?
6. Describe a curb market or other municipal market.
7. What are its advantages and disadvantages?
8. Enumerate the advantages of coöperative marketing.
9. Determine whether or not local and distant sales for these crops have increased in your section during the past five years.
10. Upon what factors does the cost of marketing depend?

The markets demand greens that are clean, crisp, and fresh. On the local markets, fresh greens are supplied every day. Spinach is the form of greens preferred in northern cities, and

this crop is, therefore, commonly shipped. Southern markets often prefer turnip greens and mustard. When crops are produced in small quantities, local markets may take the supply.

Selling Greens.—Several plans of selling these crops are found:

1. Buyers on the local track may pay cash for the products f.o.b. the cars at shipping time, the buyer taking all risks.
2. Shipments are made to commission firms located in market centers, the returns being made to the shippers after products are sold. The shipper stands all the risks regarding bad market conditions, freezing, or heating of products, etc.
3. A coöperative marketing association may act through a market manager in shipping the products to markets that have been located by wire or by radio reports. Market conditions may be studied closely as the expense is divided among all members. After cars are on the road they may be diverted to more favorable market centers. Sales may be made direct to jobbers, to chain stores, through brokers, through commission men, or through other special representatives.

Job 12. Keeping Records

Records with crops of greens should be kept on suitable forms, such as those shown in the Melon Enterprise. Each student should fill one set of forms with data on spinach or a similar crop. Talk with growers to obtain the data needed for this purpose.

References.—Write to your state experiment station for bulletins on these crops. The Virginia Truck Station at Norfolk has a number of valuable bulletins on kale and on spinach.

Fertilizer Calculations for Spinach.—1. A young man wishes to grow a green manure crop to turn under for early spinach. He finds the seed costs $1.00 per acre for rye and $1.50 per acre for vetch and crimson clover, and he sows all three. The labor of disking and sowing is calculated at 50 cents per acre. What is the cost for 12 acres?

2. If the growth, in problem 1, is estimated as the equivalent of a 2-ton crop of hay analyzing 2% nitrogen, how much nitrogen per acre is turned under by plowing in the green manure?

3. If he pastured livestock on the 12-acre field, and credits the pasturage at $2.20 per acre, how much net cost is this nitrogen, in problem 2, per pound?
4. If nitrate of soda costs $60 a ton and analyzes 15% nitrogen, find the cost per pound of nitrogen.
5. How much nitrate of soda per acre is required to supply as much nitrogen as that supplied by green manure in problem 2?
6. If barnyard manure contains 5 pounds of nitrogen per thousand, how much manure per acre is needed to supply the nitrogen supplied in problem 2?
7. What is the value per ton of barnyard manure containing 10 pounds of nitrogen, 5 pounds of phosphoric acid, and 13 pounds of potash? Count nitrogen value at that found in problem 4; and consider phosphoric acid worth 6 cents per pound and potash worth 4½ cents per pound.
8. If hauling and spreading barnyard manure costs $2.00 a ton, and you can buy it at $3.00 a ton from a neighbor, how much more would its nitrogen cost than nitrogen in the green manure in problem 3?

Costs of Nitrogen

(Three plans)

1. Winter legumes	2T. = 80 lbs. N.		
Seed and labor		$2.50	
Cr. Winter pasture			$2.50
Cost per lb. of N.		0	
2. Stable manure	8T. = 80 lbs. N.		
Labor of spreading		$4.00	
Cost per lb. of N.		5c	
3. Commercial fertilizer			
Nitrate of soda	533 = 80 lbs. N.		
Cost per acre		$16.00	
Cost per lb. of N.		20c	

ENTERPRISES WITH ENGLISH PEAS

Collaborator: H. H. Zimmerley, Ph.D., Director, Truck Station, Norfolk, Va.

The garden pea seems to have originated in western Asia, perhaps from the south of the Caucasus to Persia. From there it was introduced into Europe.

It is one of the most important garden vegetables, both for fresh use and for processing. The garden pea is a favorite of home gardeners everywhere. It is not only a delicious addition to the family diet but is an important source of iron and certain vitamins, essential to good nutrition.

Analysis into Jobs.—This enterprise may be naturally divided into the following eleven jobs or farm-unit operations.

Job 1. Determining Possibilities with Peas

Conditions Usually Found.—Growers are usually well satisfied with the results from this crop.

Aims.—Students should consider all factors and decide whether or not to grow English peas.

Problems for Study and Discussion

1. What acreage in your community is devoted to growing peas?
2. What is the average cost per acre for growing English peas?
3. What has been the average yield per acre in your community?
4. What is the average price per hamper for English peas?
5. How long does it take to produce a crop of English peas?
6. How could you secure the capital required to grow a crop of peas?
7. What difficulties do farmers in your community have in growing English peas for the early market?

Where English Peas are Grown.—This crop may be grown successfully in any section of the United States. In the South, peas are produced during the winter or early spring months because hot weather is not suitable for their development. The leading states in acreage in the production of early peas for market were recently given in the following order: California,

Colorado, Washington, New York, Idaho, Florida, and Texas.

The cost of producing a crop of English peas will vary from one season to another even on the same field. The cost of production varies with the season, with the amount of fertilizer used, with the rent of the land, with the price of labor, and with other factors. Several growers have estimated that the average cost per acre for English peas would probably be about $60.

Yields to Expect.—As with all crops, the yields will vary from one season to another. Factors causing the yields to vary are the season, the kind of soil, the amount of fertilizer used, and the variety. The yields vary from about 40 to 200 bushels per acre. The average is probably about 85 bushels per acre.

Prices vary during the season and from one year to another. The average farm value per bushel in Florida for the 10-year period of 1934-1943 was $1.52, and, in 1944 and 1945, $2.88.

Job 2. Choosing Varieties to Plant

Conditions Usually Found.—Farmers select an early variety for the market and grow only one variety.

Aims.—The grower should know how to select a good variety to suit his soil and market.

Problems for Study and Discussion

1. Into how many types may English peas be divided?
2. What would be the disadvantages of selecting the tall varieties for commercial plantings?
3. Make a list of the chief varieties of English peas and give leading characteristics of each.
4. What are the characteristics of a good variety for commercial use?
5. Which variety would you select to grow for the market? Why?
6. Why grow one variety only for early market?

Types of English Peas.—There are two main types of English peas, the smooth-seeded and the wrinkle-seeded. The smooth type will stand more cold and will germinate at a lower temperature than the wrinkled type and may be planted slightly earlier (Fig. 38). The sizes of plants may vary from two feet or less up to four or five feet. The low-growing varieties are spoken of as dwarf, the ones between two and four feet high are called medium, and those above four feet are called high. The medium

and high varieties have to be supported with wire or stakes, while the dwarf varieties do not need any support. Growers for the early markets usually prefer to select a dwarf variety, as they mature earlier.

The Variety to Select.—Growers want an early variety which is dwarf and one which will also stand some cold. Smooth varieties are often chosen because of their resistance to cold. The earliest wrinkled varieties will be a week or so later for market, but are of higher quality and often net more profit. A number of good varieties are available. Probably the leading

FIG. 38.—Smooth type of sugar peas, having pods so tender that they are often cooked without shelling.

early smooth variety is the Alaska Extra Early. McNeil is also smooth. The Thomas Laxton is probably the best early wrinkled variety.

For the home garden it may be desirable to plant the taller varieties. The following varieties are often recommended for this purpose: Telephone, Marrowfat, and Champion of England.

Job 3. Preparing the Soil for Planting

Conditions Usually Found.—Growers find it best to prepare a good seed-bed for peas.

Aims.—How to prepare the soil for peas so as to secure good results should be understood.

Problems for Study and Discussion

1. What soils are best for peas?
2. At what time of the year would you prepare the soil for peas?
3. What implements would you need in preparing the soil?
4. What are the advantages of deep plowing for peas?
5. How far apart would you space the rows?
6. Why is it difficult to maintain a bare fallow before planting peas?

Soils for peas should hold plenty of moisture, but free water should drain off. Early peas should have soils that warm up early. Rich sandy loam is probably best. (Fig. 39.)

Preparing the Soil.—English peas are planted for the early market during the winter or early spring months, hence it is necessary to prepare the soil in the fall or during the winter.

Fig. 39.—A heavy yield of early peas, due to good soil, good culture, and well-balanced fertilizing. (Seaboard A. L. Ry.)

The soil is turned with a tractor or with a two-horse turning plow to a depth of six to eight inches. This provides better surface drainage, turns under organic matter better, and gives a deeper bed for the roots. It is often difficult to maintain a bare fallow before planting peas because of the crop being planted very early, and weather conditions will not allow a long tillage period in advance. Just before planting time the field is cut over with a disc harrow.

The rows are spaced from three to four feet apart, depending upon the method of cultivation and upon whether or not double rows are used. Some growers plant two rows about eight inches apart and then space each pair of rows about four feet apart.

Ridging.—In some sections of the Atlantic slope, growers plant the rows on flat ridges elevated a few inches to warm the soil by drainage. This causes quicker germination. Ridges may be worked down as the plants grow several inches high.

Job 4. Obtaining Seed; Testing and Treating

Conditions Usually Found.—Practically all growers depend upon purchasing seed. Few people ever test their seed for vitality.

Aims.—The securing of good seed and the testing and treating of seed are essential for success.

Problems for Study and Discussion

1. How do the growers of your community secure seed?
2. How much seed is needed to plant an acre?
3. When should the seed be purchased?
4. How would you test seed for vitality?
5. How and why should seed be treated?

Activities.—(1) Test pea seeds by the rag-doll method. (2) Also treat seeds with semesan. (3) Secure seed catalogs and find where good seed may be purchased. (4) Rogue a field and select seed for planting.

The amount of seed needed to plant an acre depends upon whether single or double rows are used and upon how thick the seeds are planted in the row. If the seed is dropped one to the inch in single rows, it will take approximately two bushels to the acre.

Source of Seed.—Very few growers in the South ever attempt to save seed. Each grower depends upon purchasing the seed from some reliable seedsman. The order for the seed should be placed several weeks ahead of planting time.

Testing and Treating Seed.—English peas are tested by the rag-doll method as suggested in the Melon Enterprise. Pea seed should be treated before planting with semesan, using one-fourth of one per cent water solution. Soak seeds for thirty minutes. This tends to cause better germination and may aid in controlling diseases.

Job 5. Planting Peas

Conditions Usually Found.—Peas are commonly planted in drill rows by hand methods or with machine drills.

Aims.—Economical methods of planting peas for best results should be understood.

Problems for Study and Discussion

1. What method of planting would you use—hand or machine?

2. Describe the working of a machine planter.
3. How deep would you cover the seed?
4. At what time of the year would you plant peas in your region?
5. How much seed is needed for an acre in your plan of planting?

Planting Peas.—English peas may be sown by hand or with a hand or horse drill. Wheel planters pushed by hand may be adjusted to suit any rate of planting desired. This method is very rapid as the planter opens the row, drops the seed, and covers it in one operation. The planter also marks the next row.

Spacing.—The seeds are spaced about an inch apart in the row and the rows spaced three to four feet apart. The seed should be covered from one to two inches deep depending upon the amount of moisture present in the soil at planting time. It will take approximately two bushels of seed to plant an acre.

Ridge Planting.—Germination of seed in cold soil in early spring is hastened by planting on flat-top ridges or on the south side of ridges thrown up with a plow. Soil thus ridged is warmed earlier and the crop is ready for market earlier.

Job 6. Providing Plant Food; Applying Fertilizers

Conditions Usually Found.—Growers usually buy ready-mixed fertilizers for this crop.

Aims.—How to choose suitable fertilizers to use in connection with green manure or other farm manures, and how and when to apply these should be understood.

Problems for Study and Discussion

1. What are the kinds of fertilizers used in your community for peas?
2. What is the best method of supplying vegetable matter?
3. At what rates are commercial fertilizers applied?
4. How many different applications are given?
5. Under what conditions would you mix fertilizers at home?
6. How much is saved by buying fertilizers in car lots?
7. Calculate a fertilizer mixture which will analyze 4-8-4 (N-P-K).

Activities.—Compare two plans of providing organic matter, and note results.

Organic Matter.—This crop requires plenty of plant food. Organic nitrogen is very important. This may be supplied by turning under legumes as green manure, and by the application of barnyard manure.

Applications.—Growers usually use from 600 to 1,000 pounds of commercial fertilizer per acre. The formulas differ slightly, depending upon the nature of the soil. One used by many

growers is 4-8-4 (N-P-K). It is probably best to make two applications of the fertilizer, one before planting and one when the peas get about four inches high. Where the growth later shows a lack of nitrogen, an application of one hundred pounds per acre of nitrate of soda may be used. This should be applied about the time the peas are beginning to bloom (Fig. 40).

Mixing of Fertilizers.—If green manure or other organic manure is turned under, growers should buy fertilizers carrying

FIG. 40.—Heavy vine growth without many peas, resulting from too much mineral nitrogen not balanced with phosphoric acid and potash.

only a little nitrogen but more phosphoric acid and potash. A 2-12-4 mixture should meet the needs. In such cases as well as in others, home mixing may be practiced to advantage. Car-lot purchases are often possible for large areas or if several growers pool their buying. Much freight is saved and better prices are secured.

Job 7. Cultivating Peas

Conditions Usually Found.—Successful growers give peas frequent shallow cultivation.

Aims.—The purposes and methods of cultivating peas to secure best results should be known.

Problems for Study and Discussion

1. What implements are needed for cultivating English peas?
2. What are the main reasons for cultivation?
3. How often would you cultivate peas?
4. Discuss shallow vs. deep cultivation.
5. Under what conditions would it pay to use a paper mulch and not cultivate?

Cultivating English Peas.—This is usually done by using some form of a horse-drawn cultivator. The cultivation should be given at frequent enough intervals to prevent all growth of grass and weeds (Fig. 41). All of the cultivation should be shallow, and it is best to cultivate when the plants are dry. For this reason implements with small shovels are used. If planting is on ridges or on the south side of ridges, care must be exercised not to expose roots or cover plants while small.

FIG. 41.—Dwarf early peas, showing clean cultivation, when first picking begins. (H. B. Peschau, N. C.)

Using a Paper Mulch.—In some regions where rains prevent cultivation, grass and weeds are controlled by covering the soil with paper specially prepared to withstand weathering. The cost of paper is great and it is seldom used when not necessary. If paper is used between rows, the drills are placed close together and all labor for cultivation is saved.

Job 8. Controlling Diseases and Insects

Conditions Usually Found.—Growers find this crop less subject to insect and disease pests than many other garden crops.

Aims.—How to identify these pests and their effects and how to control each enemy should be known.

Problems for Study and Discussion

1. Make a list of the diseases and insects attacking peas.
2. Identify each of the diseases.
3. How are each of these controlled?
4. Give details regarding control of aphids.
5. What are the objections to spraying English peas?
6. Discuss pea weevils and their control.

Disease Enemies.—The most important diseases of English peas are mildew, leaf spot, stem blight, and root rot.

The mildew appears on the leaves and pods as a grayish mold. It is worse in damp weather.

The leaf spot or pod spot appears as dark blotches on the leaves and on the pods and sometimes attacks the seeds.

The stem blight causes the stems to turn brown and rot.

The dry rot of the roots is called root rot. The entire plant may rot off or wilt from the disease.

Remedies.—Crop rotation and the treating of seed as described in Job 5 are the chief aims of control. Immune strains of seed may possibly be secured. Avoid saving seeds from fields which are attacked by disease.

Pea Lice.—The worst insects causing damage are the aphids. The aphids are large green plant lice. They suck the juice from the young plants, causing them to be weak and sickly. They frequently ruin pea crops.

Control aphids before they become very abundant. Use dust containing 3 per cent of nicotine made up of 7½ pounds nicotine sulfate mixed with 92½ pounds lime dust. Apply dust on a calm, warm day. Nicotine sulfate and soap spray may prove satisfactory for a home garden if dusting is inconvenient.

Pea Weevils.—These minute beetles are most serious in southern regions. The larvæ infest the seeds and are introduced into fields when infested seeds are planted. The weevils pass the winter in the pods and seeds.

Examine seeds before planting and be certain to treat seeds with semesan. If seed is stored during the winter it should be treated in the fall in a closed vessel using carbon bisulfide, at the rate of one tablespoonful for five cubic feet of space. The liquid is placed in a saucer on top of the lot of seed and the vessel covered tightly. Avoid fire or burning light near the fumes and avoid breathing them.

Job 9. Harvesting, Grading, and Packing

Conditions Usually Found.—Peas for table use are picked by hand. Grading and packing methods have not been well standardized.

Aims.—How to pick, grade, and pack peas for best results should be understood.

Problems for Study and Discussion

1. How can you tell when peas are ready to harvest?
2. How does the cost of picking compare with all other labor costs?
3. How many hampers of peas can one person pick in a day?
4. Try to formulate rules for grading peas.
5. Discuss the best containers for shipping peas.
6. How are peas packed?

Picking Peas.—English peas are picked by hand just as soon as the peas are about grown but before the pods begin to turn

FIG. 42.—Harvesting early peas. Corn for roasting ears is growing between the rows of peas. (A. J. Geiger.)

white or ripen. Experience aids in knowing the exact stage at which to pick peas. Growers usually pick over a field three or four different times at intervals of several days. Picking is one of the most costly labor items in the production of peas. In certain communities the pickers are paid by the hamper (Fig. 42), and in other places they are paid by the day.

Grading Peas.—Peas are seldom graded after they are picked. The pickers usually leave any ill-shaped or diseased pods on the vines or fail to put them in the picking basket. Any grading necessary should be done by the pickers in the field. Points to consider are maturity, size of pods, and freedom from blemishes.

Crates for Peas.—Peas are packed for market in baskets and in hampers. The round basket holding one bushel is becoming

popular in certain localities. In many sections of the South the same type of hamper that is used for snap beans is used for peas.

Packing Peas.—There is no certain way to pack peas in the hamper. Care should be taken to prevent injury to the pods. The pods are placed in the hampers until they are an inch above the tops of the hampers so the pods will not be loose after settling. The top is then put on and nailed.

Job 10. Marketing Peas

Conditions Usually Found.—Peas are shipped by express or freight to commission merchants or sold to local buyers.

Aims.—Marketing problems should be studied and solved to best advantage.

Problems for Study and Discussion

1. How do growers in your community market the pea crop?
2. What are the advantages of coöperative marketing?
3. How may a grower keep up with market information?
4. Debate: Selling to buyers at shipping point vs. consigning to commission merchants.

Marketing Peas.—Peas deteriorate in quality very rapidly after they are harvested if exposed to wind or warm sun. Place the filled baskets in shade and then rush them to market or to refrigerator cars as soon as possible. The early pickings are sent to market by express when small quantities are being marketed. This method is expensive and should be discontinued as early as cars can be filled. Later in the season car-lot shipments are usually made under refrigeration because peas heat badly in transit. Cars can be filled earlier if coöperative marketing is practiced.

In some cases, buyers are present to purchase the peas brought to the shipping point by growers. They ship in car lots by combining products of different growers when necessary. The most of the crop, however, is consigned to commission men in the large cities. This method presents many dangerous features for the shipper.

Job 11. Keeping Records

Pea records are kept on forms similar to those shown in the Melon Enterprise.

Calculations.—1. The total acreage for green peas for fresh consumption for a year was 36,820 acres, with a yield of 2,454,000 bushel hampers. What was the average yield per acre?

2. The average price per hamper for the same time was \$2.18. Find the average income per acre.

3. If the total cost for growing an acre of peas is \$75, what percentage of profit would a grower make?

4. Find the current cost of seed for 5½ acres if 1¾ bushels are planted per acre.

5. What would be the cost of 600 pounds of a 4-8-4 (N-P-K) fertilizer, made up of nitrate of soda, superphosphate, and muriate of potash?

6. An express shipment of 315 hampers of peas was sold by a commission merchant at \$2.10. If cartage was 10 cents per hamper, express charges 60 cents per hamper, and the selling charges 5% of the sales, what did the grower receive?

ROOT-CROP ENTERPRISES

Collaborator: Julian C. Miller, Ph.D., Professor of Horticulture, Louisiana State University

Root crop is the general term applied to a group of vegetables including parsnips, turnips, radishes, carrots, and beets. In truth, however, the edible underground portion of these crops is primarily stem tissue.

These crops are native to Europe or Asia and have been under cultivation for two thousand years or longer. As a group they are important sources of food in many areas of the world.

Analysis into Jobs.—In this enterprise are included carrots, parsnips, salsify, turnips, radishes, and root crops of minor importance. Each enterprise may be analyzed into the following jobs.

Job 1. Determining Possibilities with Root Crops

Conditions Usually Found.—Root crops are grown in all states for home use or for market. In the warmer climates the root crops requiring cool weather are grown mainly during the fall, winter, and early spring months. Carrots, beets, parsnips, and salsify are increasing in importance, as they withstand the summer heat in most sections.

Aims.—Growers should understand the requirements of each root crop, and should study the possibilities concerning each crop separately.

Problems for Study and Discussion

1. Determine the crops that are included in this enterprise.
2. What root crops are grown commercially in your community?
3. What others are grown for home use?
4. Determine, by asking several farmers, how much each root crop yields per acre.
5. Study the market conditions and requirements.
6. Confer with grocers in your community and determine what quantities of root crops are consumed.
7. Compare the production costs per acre with those of other crops.
8. With what regions must your community compete in the markets?
9. Determine the sources of the root crops sold in your community.
10. Compare the costs of production with prices paid to growers.

11. Confer with growers to determine in what jobs the high peaks of labor occur.
12. What are the possibilities of growing these crops for canning in your region?

The root crops, somewhat in order of popularity in southern states, are beets (Fig. 43), carrots, turnips (rough-leaf), rutabagas (smooth-leaf), radishes, parsnips, salsify (common, black, and Spanish), horse-radish, turnip-rooted chervil, and skirret. Beets, carrots, and turnips are grown most extensively for market. The less popular root crops are grown mainly for local markets and home use. The horse-radish is grown for home use and for sale to pickling and other factories.

Regions.—Carrots are grown for markets and for canning in Texas, Mississippi, Louisiana, Virginia, and North Carolina. About half of the crop of the United States is grown in those states. California leads in the whole country. Texas, Mississippi, and Louisiana ship 1,000 cars of carrots in one year.

The Cost of Growing.—Carrots are probably the most expensive of the root crops, and turnips are the least expensive. The following is the cost per acre of growing carrots as given by the Mississippi Station in Circular 39.

Items	*Amount*	*Cost*
Seed		$11.63
Fertilizer	1,125 lbs.	30.53
Hampers	93	18.60
String	1 lb.	.25
Man labor	31.3 days	46.95
Horse labor	11.2 days	12.93
Equipment labor	11.2 days	3.03
Rent of land	1 acre	9.00
Total cost per acre		$132.92

Labor.—The job of thinning the young plants requires considerable hand labor. The harvesting job is most laborious, particularly for those root crops that must be washed and bunched.

Prices.—The five leading states in the southern region in the production of carrots receive a little over 50 cents per bushel, but much of the crop is sold in the form of early bunch carrots.

Returns per acre have been averaged as follows: beets, $193; carrots, $239; turnips, $133; radishes, $217; parsnips, $289.

Yields.—Conservative yields, as reported in bushels per acre by successful growers along the Carolina coast, are listed as follows: beets, 330 to 450; carrots, 300 to 450; turnips, 300 to 400; parsnips, 300 to 400; salsify, 200 to 300 bushels. Radishes produce about 2,000 bunches per acre.

Canneries, if located in the region, will usually supply a reasonably sure market for carrots and beets, grown to suit this purpose.

Job 2. Choosing the Crop and Its Varieties

Conditions Usually Found.—Carrots and beets are often grown for shipment, for local markets, and under special contracts for canning. Turnips and radishes are also grown for local and distant markets. Salsify and parsnips are grown to a very limited extent.

Aims.—Growers should be able to decide which of these crops, and what varieties of each, to grow.

Problems for Study and Discussion

1. Find which of these crops are most grown in your community. How extensively?
2. What are the advantages of a community specializing in one market crop?
3. Determine by local inquiry what special factors favor growing one of these root crops in your community.
4. List and compare the leading varieties of beets; of carrots.
5. Compare the types and varieties of turnips.
6. Name good varieties of each of the other root crops.
7. Why should a community usually grow only one variety for market?

Activities.—Collect different types and varieties in the market and write descriptions of them. Collect pictures from catalogues to illustrate note-book descriptions.

Varieties.—It is well to select the variety of each crop that is demanded by your market. For instance, the French Breakfast radish may be demanded in one locality and the White Icicle variety in another. At the present time the following varieties are outstanding and popular, Chantenay leading other varieties.

Beets	*Carrots*	*Turnips (Rough Leaf)*
Detroit	Chantenay	White Egg
Egyptian	Danvers Half-long	Early Milan
Eclipse	Improved Long Orange	Golden Ball
Blood Turnip	Nantes or Coreless	Purple Top White Globe

Rutabaga	*Radish*	*Horse-Radish*
Purple Top Yellow	French Breakfast White Icicle Scarlet Globe Long Scarlet	Bohemian
Parsnip	*Salsify*	*Winter Radish*
Guernsey	Mammoth	Chinese Rose

FIG. 43.—Beets grown for early market by George Hermann, Jr., Virginia; ready in May; a good early-spring crop.

Special strains of the varieties often differ very much. Select those best suited to the purpose for which they are grown. Strains of the Chantenay carrot of uniform dark orange, free of core, are desired for canning. Beets best suited for canning are those of dark red color and free from fiber or woody growth.

Market Preferences.—In growing these crops for market, earliness, quality, and yields are very important and should always be known before planting. The leading marketable root crops are carrots, beets, turnips, and radishes. Market preferences as to varieties should always be taken into consideration.

Job 3. Selecting the Soil and the Field; Planning Rotations

Conditions Usually Found.—The location of the field used for these crops is too often predetermined by other crops. Unfavorable soils are too often used.

Aims.—Growers should understand how to select soils and locations offering the best advantages, and how to plan favorable rotations.

Problems for Study and Discussion

1. What soils in your community are used for growing these crops?
2. What rotations are followed by farmers in your community?
3. Show how to secure organic matter for soil by a good rotation plan.
4. Show the relation between soil and earliness of crop.
5. Why do early crops require a different soil from those grown for canning?
6. Why consider soil parasites when choosing a field? When planning rotations?

Soil Preferences.—Beets and carrots thrive best in loose, loamy soils with high organic content. Sandy loam soils are preferable for early crops. When earliness is not an important factor, heavier soils, as silt loams or muck soils, produce more satisfactory returns because of larger yields. Parsnips require deep rich soils as they grow crooked in poor and shallow soils. The turnips and radishes grow on almost all types of soil, but do best in deep, rich loams. Extremely heavy or light soils are objectionable. Shallow soils result in irregular and ill-shaped root development.

Rotations may be planned so that a crop of organic matter is plowed into the soil for the production of humus. Cowpeas or, in many sections, sweet clover may well precede the root crop. Avoid following crops which are hosts of nematode parasites and plant lice, as these will also attack root crops.

Location of Field.—To save labor of handling, it is best to plant these crops in fields easy of access with teams and trucks. Root crops are rather bulky and should be handled as little as possible, so as to preserve both roots and tops. Minimum handling results in better quality and reduces labor.

Job 4. Preparing the Soil for Planting

Conditions Usually Found.—Soil is often poorly prepared with resulting crop losses or reduced quality.

Aims.—Growers should understand the best methods of preparing soil for planting root crops.

Problems for Study and Discussion

1. For which root crops should the soil be plowed deep?
2. Which root crops require the finest seed-bed?
3. Give the advantages of a bare-fallow period before planting.
4. How can the surface of the soil be smoothed without rolling?
5. Under what conditions should a roller be used?
6. What types of rollers are best?

Activities.—Compare results of growing a crop in two ways: (1) with a harrowing period of three weeks between plowing and planting time; (2) with the soil plowed, harrowed, and planted all in one or two days.

A bare-fallow period of a few weeks after the soil is plowed with a turning plow should be planned. Harrow the soil about once a week during this period. Then plant the crop. The effects of this bare-fallow treatment are listed in chart form. These may be placed on a chart or blackboard for discussion. Try to explain each point. A very fine seed-bed is required for those seeds usually having low and weak germinating power, as beets, carrots, parsnips, and salsify.

Depth of Plowing.—Those root crops which are to occupy the soil for the longest time and produce the deepest roots require deep plowing when the soil is turned. Plow deep for beets and carrots if they are to be grown to full size, and for rutabagas, parsnips, salsify, and horse-radish. Shallow plowing may suffice for short-season crops of beets, carrots, turnips, and radish. Heavy soils require deeper plowing than light soils.

Rolling or planking is helpful if the surface is cloddy. A plank drag smooths the surface without packing the soil much. When soil has been plowed just before planting time, when a heavy growth of green manure is plowed under, or when the soil is very dry, rolling will help to remedy the difficulty. Use a culti-packer or other rough roller. A smooth roller hardens the surface too much, and is not so satisfactory as other types.

Job 5. Providing Plant Food; Applying Fertilizers

Conditions Usually Found.—Green manure, barnyard manure, and commercial fertilizers are used for these crops. Home-mixing of fertilizers is gaining in popularity.

Aims.—How to plan a cropping system to supply green manure, how to use barnyard manure without injuring root crops, and how to use other fertilizers to best advantage should be understood.

Problems for Study and Discussion

1. Learn how local farmers supply green manure for these crops.
2. When do they apply barnyard manure? Give reasons.
3. What fertilizers are best to supplement green manures and barnyard manure?
4. When should these be applied for early crops? For long-season crops?
5. Give suitable rates of application for light soils; for heavy soils.
6. Give advantages of buying fertilizers coöperatively.
7. What farmers in your community use home-mixed fertilizers?
8. What reasons do they give for this practice?
9. What plant-food carriers are best and most economical?

Activities.—Compare results when one of the root crops is grown under two different treatments for supplying plant food.

Organic matter in the soil is very beneficial for all root crops. It helps those most which occupy the soil during warm or dry weather. The green manure used should be well rotted and incorporated into the soil by several harrowings of the soil after plowing. Barnyard manure should be rotted before it is spread on the field, to avoid causing weeds and surface disease on root crops. If a disk harrow is used before plowing, the organic matter may be better mixed with the soil. Some stations recommend as much as sixteen tons per acre of barnyard manure.

Commercial fertilizers, in addition to organic manures, are beneficial for root crops. For quick-growing, early root crops use commercial forms of fertilizers, as nitrate of soda or sulfate of ammonia, superphosphate, and potash. Turnips and radishes are somewhat affected by fresh lime; carrots less so; beets, salsify, and parsnips to a much less degree.

For the crops grown for early market, apply fertilizers when the crops are planted or as soon as growth is well started. Later applications may be given, in addition, for long-season crops.

Supplement the organic manures with about one-half ton per acre of commercial fertilizer containing 4 per cent nitrogen, 7 per cent phosphoric acid, and 6 per cent potash on a medium loam soil. Increase the amount of nitrogen if there is little organic matter. Increase the amount of potash for carrots. Less potash is needed on clay soils for other root crops.

Coöperative buying reduces costs, and makes it easier to secure the separate ingredients such as those mentioned.

Home-mixing of fertilizers for root crops is chiefly beneficial because growers can apply just what is needed to suit the soil and the crop. (See chart in *Southern Field-Crop Enterprises.*)

Job 6. Obtaining Seed; Planting the Crops

Conditions Usually Found.—Poor lots of seed of beets, carrots, and parsnips cause poor stands in fields. Seeds are planted both by hand and by mechanical planters.

Aims.—How to secure good seed; how to test and treat seed; and how to economically plant seed to secure best results should be understood.

Problems for Study and Discussion

1. Explain why root crops are usually grown from seed, rather than by transplanted plants.
2. Which crops of this group are sometimes transplanted?
3. What quantities of seed should be used?
4. At what periods of the year are these crops planted in your state?
5. Give advantages of treating and soaking seeds.
6. Give directions for planting each of the root crops.

Activities.—Read U. S. Farmers' Bulletin 948 and then test seeds of beets, carrots, and parsnips. Treat seeds of these root crops before planting, using semesan. Compare results from treated and untreated beet seeds.

Seeds.—Beets, carrots, parsnips, and salsify are true biennial plants and rarely produce seeds until the second year. Seeds of the root crops are commonly obtained from dealers. Some of these seeds are very slow in germinating, and should be treated or at least soaked in water before planting to hasten the germination and to produce a better stand.

Level Planting vs. Ridging.—Level planting saves time and labor at planting time and during the cultivation season. In dry seasons the crops suffer less from drouth. Less hand work is needed to keep rows free from weeds. Soils having poor drainage, if used for root crops in wet seasons, should have each row ridged, or wide beds may be thrown up for planting several rows, and water furrows should be left to aid in draining off free water.

Methods of Seeding.—Both hand and mechanical seeding give good results. Drilling with garden planters is more economical of time and usually results in more uniform stands.

Beet "seeds" are usually sown in drills or rows about eighteen inches apart. About eight pounds or more of "seed" are required to the acre. Beet "seeds" are really groups of seeds and vary

in size. A more even distribution of seeds can be made if they are sifted. Seeds are covered about one inch.

Carrot rows are spaced about sixteen or eighteen inches apart and the seeds are planted in thick drills. About three pounds of seed are required per acre. The covering should be about one-half inch or a little more.

Parsnip seeds should be planted thickly in drills fifteen to eighteen inches apart. About six pounds or more of seed are required per acre. These are covered about one-half inch or more deep.

Turnips are drilled in rows twelve to eighteen inches apart. Seeds are covered to a depth of about one-half inch. Two or three pounds of seed are required per acre for drilling. Sometimes turnips are sown broadcast and covered by harrowing or by rain. This plan requires about five pounds of seed per acre.

Radishes are often grown as an intercrop or as a companion crop, or they may be sown broadcast. Radish rows are spaced twelve to fifteen inches apart, requiring ten pounds or more of seed per acre. The covering depth is nearly one inch.

The other root crops are usually grown in drill rows. The row spacings given above are for cultivation with wheel hoes. When planted for horse cultivation, rows should be spaced wide enough to suit implements to be used. The planting of sufficient seed is economical and offers greater assurance of profit.

Planting on settled soil and in freshly opened rows results in more satisfactory stands. On dry and unsettled soil, firming the surface after planting is recommended.

Transplanting.—The root crops are usually grown from seeds. Beets are sometimes planted in a hotbed or cold-frame and later transplanted to the field. This is not economical unless a high price can be obtained by having an early crop. Sometimes broken stands of root crops are filled in by transplanting, thinnings being taken from other parts of the row or field. Horse-radish seeds seldom mature; therefore, this crop is propagated from root cuttings.

Time of Planting.—The cool weather root crops can be grown in fall, winter, or early spring, depending on the latitude. The crops may go to market when there is no competing northern crop. In the southern states the long-season crops, as parsnips

and salsify, are seldom grown except for home use. They may be started in very early spring.

Job 7. Cultivating the Crops

Conditions Usually Found.—Much cultivating of root crops is with wheel hoes pushed by hand. Horse tillage is not uncommon. Crops when sown broadcast are not harrowed nor cultivated.

Aims.—Growers should understand the cultural requirements, and the most economical practices.

Problems for Study and Discussion

1. Determine by local inquiry the tillage practices of successful growers.
2. What horse implements are most commonly used by local growers?
3. What hand wheel hoes are most popular?
4. What hand weeding and thinning are necessary?
5. Describe the work of thinning root crops.
6. How often are these crops cultivated in your section?
7. What are the main reasons for cultivating?
8. How long should cultivation of a crop be continued?
9. Discuss depth of tillage.

Activities.—Compare results from growing turnips in cultivated rows and others grown from broadcast sowing and having no cultivation.

Thinning root crops is often necessary. Several beet plants come from each "seed" and must be thinned (Fig. 44). Other root crops are drilled thick and then thinned to suit space requirements. Thinning is chiefly done by hand. This is tedious work and should be avoided in as far as possible. Thinnings are often used at home or may be large enough to tie in bunches for market. Young tops of turnips and beets are used as greens.

Cultivation.—Systematic and thorough cultivation pays. Intensive cultivation should be given root crops in the early stages of growth to keep down weeds and force the plant growth. Most cultivation is done by use of hand wheel hoes, and soil is gradually worked toward the plants. Wheel hoes with knifelike attachments and cultivator teeth are used. Hand hoeing is often necessary but should be avoided where possible because of expense. Clean, shallow cultivation should be given as often as necessary to keep down weeds and prevent the formation of a crust on the soil (Fig. 45). The absence of cultivation and resulting slow growth are often responsible for poor quality in crops sown broadcast.

Giving a side application of fertilizer is a common practice. Root crops must make continuous and rapid growth to be of best

FIG. 44.—Agricultural students in group practice, thinning and weeding beets. (A. J. Geiger, Agr'l Teacher.)

FIG. 45.—Using a garden tractor cultivator in project with beets. Rows fifteen inches apart and properly thinned.

quality. The usual plan is to use 50 to 150 pounds nitrate of soda following the thinning of the crop. This is usually cultivated into the soil immediately. Applications of commercial fertilizers made after the crop is one-third developed are usually of little value, and are not profitable.

Job 8. Controlling Diseases and Insects

Conditions Usually Found.—Experienced growers usually know how to combat the several different insects and diseases, but perplexing difficulties often arise.

Aims.—Growers should know how to identify the diseases and insects attacking these crops and how to control them.

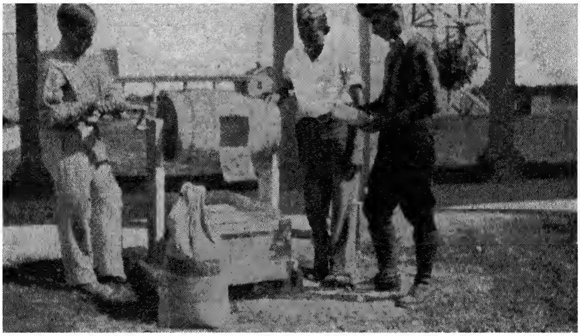


FIG. 46.—Texas agricultural students, with shop-made equipment, preparing nicotine dust for use on plant lice. (Photo by J. H. Seward, Courtesy C. L. Davis, State Supervisor, Austin, Tex.)

Problems for Study and Discussion

1. Make a list of diseases which injure the local root crops.
2. Find from local farmers what they do to control each disease.
3. What insects are most injurious to root crops in your community?
4. Discuss the control measures practiced for each insect.
5. What is the effect of the squash bug? Give control measures.
6. Describe the work of plant lice.
7. What insects are controlled by dusting or spraying with arsenate of lead?
8. What insects are controlled by using nicotine sulfate?
9. Why should fields of turnips and similar root crops be plowed and cleaned up as soon as the crops are harvested?
10. How may a grower avoid planting root crops in soils which are infected with nematodes?

Activities.—Specimens of insects attacking root crops should be collected and preserved as described in U. S. Farmers' Bulletin 1601. Make a dust-mixing device as shown in Fig. 46.

Beet leaf-spot is a very common disease on plants of the beet family. The leaves have spots of ash-gray color and irregular purplish borders. The spots often drop out, giving the leaf a riddled appearance, or the leaves may die and remain standing.

Thorough cleaning up of refuse after harvesting, and rotation of crops are beneficial. Spraying with Bordeaux mixture gives some control but is not commonly practiced. Crops of the beet family should be omitted from the rotation.

Scab.—This disease often attacks beet crops seriously. The trouble is increased by excessive use of lime or of fresh barnyard manure. The treatment of seed before planting, as described, will prevent the introduction of scab disease into new soils. Avoid growing the crop on a soil on which a scabby crop of beets, potatoes, or other root crops has been grown. The disease is similar to that found on Irish potatoes.

Beet Leaf-miner.—Small white worms, about one-third inch long, burrow into the tissues of beet leaves, making them unfit for food and checking foliage growth. Plowing immediately after harvest will aid in the control of this insect. Planting in the cool season is advisable. Spraying is of no value because the insects cannot be reached.

Webworms attack beets and other plants of that family by eating the tender leaves from the underside or under cover of small webs which the insects spin. Spraying or dusting with arsenate of lead is only partly effective, because the insects are protected. Fall-grown beets are troubled to a greater extent by webworms than are spring crops.

Enemies of Rutabagas, Turnips, and Radishes.—These crops are subject to practically the same diseases and insects as are given in the Cabbage Enterprise. The serious diseases are club-root and black-rot. The most injurious insect pests are aphids, root maggots, and flea beetles. Squash bugs and harlequin bugs are sometimes troublesome, particularly to rutabagas. Spraying or dusting with nicotine sulfate is only partially effective and should be combined with clean-up measures. Nematodes may be detected in a field by observing their attacks on crops previously grown there; or they may be discovered, if present, by growing a little lettuce in suspected places. (See Cabbage Enterprise.)

Other Foliage Insects.—Other root crops are sometimes attacked by foliage-eating insects. Carrot worms strip the leaves from carrots and parsnips. Dusting or spraying with arsenate of lead or arsenate of lime is usually effective.

Insecticides.—Arsenate of lead and arsenate of lime are stomach poisons, and chewing insects are killed by actually eating some part of the foliage which is covered with a thin film of this material. Sucking insects, as squash bugs and plant lice (Fig. 47), are controlled by contact sprays or dusts such as nicotine sulfate. They cannot eat arsenical poisons.

Job 9. Harvesting and Marketing

Conditions Usually Found.—Root crops are too often carelessly harvested, poorly graded, and packed in bunches of irregular size, and too often appear on the markets in poor condition.

Aims.—Best methods of harvesting, grading, packing, and marketing each of the root crops should be well understood.

Problems for Study and Discussion

1. Determine by local inquiry how root crops are harvested and prepared for market by growers.
2. How large should root crops be before being harvested?
3. How should root crops be prepared for (a) local market; (b) distant shipment?
4. How can root crops be stored?

Fig. 47.—Vocational student, Frank Tamborella of Texas, fighting plant lice on turnips by dusting with nicotine sulfate. (J. H. Seward, Texas Agr'l Teacher.)

5. What root crops may be left unharvested in the ground throughout the winter?
6. Describe bunching of root crops.
7. What determines the sizes of bunches?
8. Describe the management of a horse-radish crop.
9. What methods of marketing root crops are used by local farmers?
10. Why are root crops seldom shipped by express to distant markets?

Activities.—Participate in the harvesting, grading, bunching, packing, and marketing of root crops. Visit markets and compare different methods seen there. Make a washing vat and bench for bunching root crops (Fig. 48).

Harvesting.—Root crops that are bunched should be pulled and handled in such manner as to preserve the tops, prevent bruising of the roots, and to protect from wilting as much as possible. Radishes should be harvested when very young to

avoid the formation of pithy growth and strong flavor. Care must be exercised to avoid waiting until other root crops, as carrots, and beets, have become woody. Young roots are usually preferred. (Fig. 49.)

Bunching.—The roots when pulled are washed and the broken and discolored foliage is removed. Then they are tied in bunches of nearly uniform size. The roots in each bunch are also nearly uniform in size. The sizes of the roots and the markets govern the numbers in the bunches. In general the numbers vary as follows: beets, 4-6; carrots, 8-12; parsnips, 4-6; radishes, 6-12; turnips, 4-6. Some markets require that leaves be cut off. In that case the stems of the leaves are tied together. Tops are reduced more for distant shipments than for neighboring markets. (Figs. 50, 51, and 52).

FIG. 48.—Wash bench where root crops are tied in bunches for marketing.

Packing for shipment should be done promptly after bunching. Crates, baskets, and hampers of different styles and sizes are in use. They are always well ventilated. The commoner packages are listed: beets, $1\frac{1}{2}$ bushel crates and baskets; carrots, turnips, and radishes, bushel baskets and crates.

Horse-radish is dug and the roots are tied in uniform bunches without the tops; or it is otherwise packed to suit special markets. Growers sometimes grind the roots, bottle in clear vinegar, and sell to consumers or to stores.

Icing.—The more expensive root crops, as early beets, radishes, and carrots, are often iced before shipment. Cracked ice

will insure much better delivery of these products. A good practice is to put two to three layers of finely cracked ice in each container. Large pieces of ice will bruise the roots and give irregular cooling. From 25 to 40 pounds of ice is sufficient for 200 to 240 bunches of radishes.

Selling of root crops is managed in the different ways given for greens, to which refer.

For canning, the tops are removed from beets and carrots before delivery to the factory. The diameters of the roots, at the

FIG. 49 FIG. 50

FIG. 49.—Vocational student in rutabaga project harvesting roots. (A. J. Geiger, Agr'l Teacher.)

FIG. 50.—Vocational students in group practice, washing beets and turnips after bunching for market. (A. J. Geiger, Agr'l Teacher.)

crowns, are usually uniform and in keeping with the requirements of the canning factory.

Storing.—Turnips, rutabagas, carrots, and beets are sometimes stored. However, by reason of the mild southern climate, they are often left unharvested in the field until needed. Parsnips and salsify are usually left in the ground and harvested as needed. These crops, after tops are removed, may be stored in soil banks or cellars as are Irish potatoes, which see.

Job 10. Keeping Records

Root-crop records are readily kept on such record forms as those shown in the Melon Enterprise. Each student should ob-

FIG. 51.—Winter-grown carrots, washed and bunched ready for packing. (Seaboard A. L. Ry.)

FIG. 52.—Group project with root crops. First lesson in bunching and tying turnips and beets for market. (A. J. Geiger, Agr'l Teacher.)

tain data on one crop from a good grower and fill one set of forms before beginning a set of records on his own projects. This set should be summarized in the regular way to show the net profit and the labor income from the enterprise.

Root Crop Calculations.—1. If beets are spaced 4 inches apart in rows that are 3 feet apart, how many can be produced per acre?

2. Secure catalog prices of seed and determine the cost of seed for planting an acre, if beets take 5 pounds of seed, carrots 2 pounds, turnips 2 pounds, and radishes 10 pounds.

3. A young man spaced beets as in problem 1 and sold them in bunches of 6 at 5 cents per bunch. What was his gross income per acre if 5% were culled out?

4. The acre of beets cost $100 to produce and market. Determine the percentage of profit made on the investment.

5. One row of carrots 100 feet in length produced 50 bunches of 8 to the bunch. At the same rate what would an acre produce if the carrots are planted in rows 2½ feet apart?

6. Two students sowed turnips broadcast, one acre each. The first harvested the crop and bunched them, selling them in crates, netting 4 cents a bunch for 7,500 bunches. The second student harvested the crop as mature turnips, netting $1 a bushel for 500 bushels. Which had the greater income and how much?

ONION ENTERPRISES

Collaborators: H. C. Thompson, Ph.D., Professor of Vegetable Gardening, Cornell University, and J. C. Miller, Ph.D., Professor of Horticulture, Louisiana State University.

The onion, a member of the lily family, has been cultivated since earliest recorded history. It probably originated in areas bordering on the Mediterranean, and historic records refer to its use as a food. It is one of the most important vegetables, since it is grown in nearly all countries of the world.

Both tops and bulbs are edible and are used for many purposes from soups to salads.

Analysis into Jobs.—Onion enterprises may well be studied under the following list of practical jobs, which include both the operative and the managerial aspects of the business.

Job 1. Determining Possibilities with Onions

Conditions Usually Found.—Onions are extensively grown for early market in Texas, Louisiana, and for home use and local market in each of the southern states.

Aims.—All factors which affect probable profits should be considered carefully before this enterprise is undertaken.

Problems for Study and Discussion

1. To what extent are green onions or ripe onions grown in your region?
2. Report opinions of growers regarding the growing of onions for market.
3. Report prices per acre received for onions in recent years; prices per bushel or crate.
4. Determine the growing period for green onions; for ripe onions.
5. In what jobs do the high peaks of labor occur?

Activities.—On forms made up from the Melon Enterprise records, fill in data from the best local growers regarding cost of each of the jobs, results of sales, and summary of profits.

Onions in the South.—The onion is one of the most important truck crops of Texas, Louisiana, and some sections of other states of the southern region. The onion crop is well adapted to

growth in the winter. It thrives well in cool moist weather. Green onions sold as bunch onions in markets are grown in fall, winter, and spring.

Production and Prices.—The average yield per acre for the ripe onion crop is approximately 300 bushels for the whole United States. In regions where the crop is grown intensively the average is often nearly double this amount. Prices vary considerably for both the early green crop and for onions stored until winter. Prices are low in some years when the production is unusually great.

Capital and Labor.—The capital requirements for onions are no greater than for most other truck crops. The greatest amount of labor occurs at harvesting time. Topping is often done by hand and much labor is involved. Another high peak for labor occurs when the crop is being thinned or weeded by hand.

Job 2. Choosing the Type and the Variety

Conditions Usually Found.—Commercial growers understand the value of choosing the variety to suit local conditions and the markets.

Aims.—The value of growing only one variety, and how to choose a variety to suit the markets, should be understood.

Problems for Study and Discussion

1. List the varieties grown locally for green onions; for ripe onions.
2. What varieties are best for marketing?
3. Enumerate the advantages of growing only one variety of ripe onions for market.
4. Compare different types and varieties for your region; for market.

Two Types.—Onions are referred to as green-bunch, and ripe. The ripe onions are of two main types, the American and the foreign. The latter is represented by the White Bermuda, which is grown mainly in Texas and somewhat in other Gulf states. It is milder than any of the other onions and is popular on the market. American onions are smaller in size, stronger in flavor, denser in texture, and much better keepers. The American varieties are earlier in maturing and are safer for growth in the upper parts of the region. They are often used as green-bunch onions.

Varieties.—Three distinct colors are recognized among the American onions; yellow, red, and white. Markets differ in their demands regarding color. Popular varieties of these colors are Yellow Globe Danvers, Red Wethersfield, Southport Red Globe and Southport White Globe.

Varieties of Bermuda types are Red Bermuda, White Bermuda, and Crystal Wax. Prizetaker represents a group of varieties of foreign onions midway in size and strength of flavor between the American and the Bermuda. Australian Brown is often grown in the South. (Fig. 53.) Shallots are grown as winter crops in Louisiana and other states. The Creole is another important onion for the South because of its good keeping qualities. It is early in production and a very good keeper.

FIG. 53.—Australian Brown onions grown for bulbs, nearly ready for harvest. (Seaboard A. L. Ry.)

Job 3. Selecting Soil and Field

Conditions Usually Found.—Growers are more careful in selecting soils for ripe onions than for green onions.

Aims.—The special soil requirements for onions, the rotation, and the acreage should be carefully considered.

Problems for Study and Discussion

1. What local soils are best for ripe onions?
2. What soils are best for early green onions?
3. How can an unsuitable soil be improved for onions?
4. Suggest what crops in the rotation should precede onions.
5. Give objections to growing too large an area.

Soils.—Onions will not thrive on coarse, rocky soil, as they have very delicate roots. Soils that bake, or form hard crusts after rain, do not favor their germination. They may be grown on any well-drained, fertile soil, muck soils being undoubtedly the best general type for the growth of mature onions from seeds. Rich black sandy loam which is well drained is well suited to onion culture. The crop succeeds on a variety of soils, provided there is plenty of plant food. Natural fertility is highly important. Plenty of humus and well-rotted organic matter should be present.

Choosing the Field.—If possible grow onions in rotation. Plan to have a green manure crop, such as clover or grass sod,

FIG. 54.—Cowpeas grown in rows in summer as green manure for winter truck crops.

turned under preceding the onion crop. (Fig. 54.) Some growers find that such a crop is not easily worked into the soil sufficiently for onions to follow. They prefer to let a cultivated crop such as potatoes or corn follow the sod crop and grow onions the next year. The field should be well drained and located where it has a good sunny exposure to aid in the curing of the crop of ripe onions at harvesting time.

Acreage.—Good care is more important than large acreage. The labor supply should be carefully considered when planning the acreage for onions. The tendency among growers to increase or decrease the acreage should also be considered. There is some danger of overproduction. It is often better to reduce the acreage than to increase it over the acreage of the preceding year. Some sections should increase the acreage to supply the American market during mid-summer. At this time most of the Texas

and Louisiana onions are off the market, and the northern producing sections are not in.

Job 4. Obtaining Seed; Obtaining Sets

Conditions Usually Found.—Growers usually buy good seeds or sets for onions. Testing and treating seed are too seldom practiced.

Aims.—How to choose good seeds and sets and how to test and treat seeds should be understood.

Problems for Study and Discussion

1. Talk with local growers regarding obtaining good onion seeds, and give your conclusions.
2. Calculate the amount of seed needed for an acre.
3. How many bushels of sets of average size are needed per acre?
4. How are good sets obtained?
5. Discuss seeds vs. sets for green onions; for ripe onions.
6. How may onion slips or plants be obtained?
7. Under what conditions would you set onion plants instead of sets?
8. How many plants are required per acre?
9. Compare costs of seed, sets, and plants for an acre.
10. Describe testing and treating seeds.

Seed.—This is easily produced and saved by truck growers in dry climates. Good supplies of seed are found in the hands of seedsmen. Truck growers in humid climates usually buy onion seeds.

Testing onion seed by simple methods is advisable. Use the rag-doll method. The germination should be 90 to 95 per cent.

Treating onion seeds with hot water at a temperature of 122 degrees for 25 minutes as described for cabbage seed is believed by some to aid materially in controlling smut disease.

Onion Sets.—For the production of green bunch onions, sets are often used. Ripe onions are also sometimes grown from sets. True onion sets are really small onions produced as a special crop of the variety desired. They are sold in the seed markets as dry ripe onions, but must have been stored away from frost. Sometimes inferior lots are offered for sale. They should be carefully examined before purchasing. Onion sets are used for growing bulb onions for home use and somewhat for market, as well as for growing green onions.

Onion sets may be produced by growers themselves if the conditions of soil are favorable. Usually lighter soil with much less plant food is best for growing onion sets.

Top sets are often produced on seed-onion crops. These may

be harvested and used or may be purchased from seedsmen or others for use in growing either green onions or ripe onions. Shallots and Welsh onions are often grown from top sets.

Onion Plants.—In the Gulf states onion crops are often grown from transplanted plants, called slips. The seed for the growth of these plants is sown in hotbeds, or protected frames or in open, warm climates. The young plants are pulled, counted, and tied. These are offered for sale by seedsmen and other dealers.

Job 5. Providing Plant Food; Applying Fertilizers

Conditions Usually Found.—Growers realize the value of organic matter in the soil for onions, and, in addition, they often use commercial fertilizers.

Aims.—How to provide organic matter and plant foods economically should be understood.

Problems for Study and Discussion

1. What crops grown locally are best for turning under as green manure?
2. At what rates may barnyard manure be profitably applied?
3. Give the costs of buying and hauling barnyard manure.
4. What commercial fertilizers are used by local growers?
5. Give directions for applying fertilizers.

Organic Manures.—Many onion growers on non-muck soil apply twenty-five to thirty tons of new rotted manure to the acre in addition to a half ton of commercial fertilizer. Lime is used by some growers but is not so important as organic matter.

Onions should have well-rotted organic matter. When sod or other green manure crops are turned under they should be well worked into the soil by disking before and after plowing. If possible, allow time for rotting of organic matter and sprouting of weed seeds.

Plant Food Removed.—A 600-bushel crop of ripe onions removes from the soil 92 pounds of nitrogen, 93 pounds of phosphoric acid, and 101 pounds of potash. If the soil is rich in well-rotted organic matter much of the nitrogen may be supplied from the soil, but it may be advisable to supply 200 or 300 pounds of nitrate of soda per acre if the soil is not rich. The phosphoric acid may need to be supplied in the form of superphosphate (acid phosphate) but a high grade of tankage could be used for this and for a part of the nitrogen. About 200 pounds or more of muriate of potash is recommended for muck soils or for light soils, but if there is a good supply of clay much

of this may be omitted. On muck soils the fertilizer should be rich in potash.

The Cornell Station recommends N-P-K formulas such as 0-12-18, 3-12-18 and 0-10-10, at rates of 750 to 1,000 pounds per acre. Fertilizers without nitrogen are used on high-lime muck soils. A 5-10-5 mixture is suited to mineral or non-muck soil.

Applications of commercial fertilizers may be made before planting. These are harrowed into the soil. Nitrate of soda or other fertilizers may be applied to the crop between rows just before the first cultivation or after thinning is done. If heavy rains follow, one or two applications of nitrate of soda are advisable.

Job 6. Preparing Soil and Planting

Conditions Usually Found.—Very good seed-beds are prepared by successful growers. Planting by economical methods is practiced.

Aims.—The advantages and methods of good preparation of soil and good methods of planting seeds, sets, and plants should be carefully considered.

Problems for Study and Discussion

1. List the effects of a bare-fallow period of harrowing before planting.
2. Give special reasons for a good seed-bed for onions.
3. Give distances for drilling seeds; for setting plants and sets.
4. Describe good methods of drilling seeds; of setting plants; of planting sets.

Activities.—Practice these operations and calculate costs of each on an acre basis.

Preparing Field.—Preparation of soil for onions is similar to that recommended for other truck crops. It is difficult to have the surface too fine and smooth for onions, as the young seedlings are easily ruined by early cultivation if the soil is in bad condition. Weeds, volunteer grain, and the like must be thoroughly sprouted out of the soil for this crop or they will choke out the small seedlings. Thorough harrowing through a bare-fallow period to sprout all weed seeds is perhaps more important for onions than for any other truck crop. Soils infested with wild onions and/or nut grass should be avoided.

Planting Onion Seed.—Seeding should be done early as onions thrive in cool weather. Hand seeders are best for drilling onion seed. A straight line may be stretched for the first row and a side marker may be followed for each succeeding row. A one-wheel drill will open the row, drop the seed, and cover it

slightly. A packer behind will firm the surface sufficiently. Rows are commonly 12 to 15 inches apart when cultivation is to be done with hand tools. In sections of the South where the rainfall is heavy, it is common to plant in double rows 6 to 8 inches apart, on beds 3½ feet wide (Fig. 55). About 4 to 6 pounds of seed will plant an acre, but at this rate thinning will be required. If only a little over 3 pounds of good seed are used per acre, thinning often may be omitted. If good, tested seed is

FIG. 55.—The "bed" method of growing green onions, six rows to each "bed."

used the results may be rather satisfactory with 3¼ pounds of seed. Thinning is much more common on mineral soils than on muck soils.

Onion sets may be planted an inch apart in rows about 12 inches apart. They may be covered one to two inches deep.

Setting Plants.—When crops are to be grown from plants started in frames or beds, the rows are opened with suitable markers. In these the plants are set 3 to 4 inches apart by hand methods, or by the use of tongs made for the purpose. The tops are usually cut back to reduce moisture loss.

Job 7. Caring for Crop in the Field

Conditions Usually Found.—Good growers are careful and efficient in thinning, in seeding, in cultivating, and in controlling enemies.

Aims.—The need for thoroughness and the most economical methods in each of these operations in onion fields should be fully considered.

Problems for Study and Discussion

1. Give the local practices in thinning onions.
2. What hand weeding is practiced? When?
3. Describe cultivation between rows; hand tools; horse tools.
4. What diseases and insects are injurious to onions in your region?
5. Give control measures to prevent diseases, and to fight insects.

Activities.—Contrast two different methods of thinning and weeding, and of cultivating onions.

Thinning.—When ripe onions are grown for market a much more uniform product is obtained if the crop is properly thinned while small (Fig. 56). If the stand is very thick, thinning should be earlier than otherwise. Usually the work is done at

FIG. 56.—Thinning and weeding green onions. When the growth is so large many are saved for bunching. (A. J. Geiger.)

the time of the second weeding. The soil should be moist for this work, as the permanent plants will be less disturbed. Leave the strongest plants about three inches apart or to suit the variety. The bulbs should not crowd seriously. Plants pulled out are sometimes transplanted to another row.

For the green-bunch onions, thinning is very commonly done by pulling the largest onions and bunching these for market. If the plants are too crowded, some earlier thinning is necessary.

Weeding.—Onions are not good fighters of weeds. One cultivation with a wheel hoe should be made as early as possible after the plants are up. Some growers mark the row with a little fertilizer or lime to aid in locating it for the first cultivation. Hand weeding in the rows is usually necessary at thinning time.

Clean cultivation should be given the crop until the bulbs are nearly grown. Avoid forcing additional growth by late cultivation. (Figs. 57 and 58.)

Fig. 57.—A well-cultivated onion field in South Carolina, showing thrifty growth. (Seaboard A. L. Ry.)

Fig. 58.—Cultivating Australian Brown onions. Rows may be grown at distances to allow cultivation with horse tools. (J. F. Williams, S. C.)

Controlling Enemies.—Onion thrips are serious in some regions. If they are found, U. S. Farmers' Bulletin 1007 should be studied. Onion smut is a serious disease in the cool climates,

but is of little consequence. It is controlled by formaldehyde solution, 1 oz of 40% formalin to one gallon of water, applied from a tank on the seed drill at time of seed sowing. Onion diseases are common. U. S. Farmers' Bulletin 1060 should be consulted in guarding against any which may occur.

Job 8. Harvesting and Marketing

Conditions Usually Found.—Commercial growers practice good methods of harvesting, curing, grading, and marketing ripe onions. They understand bunching and handling green onions.

Aims.—Full consideration should be given to each of these operations

Problems for Study and Discussion

1. Describe the stages for harvesting green onions; ripe onions.
2. How are ripe onions harvested?
3. Give methods for green onions.
4. Give need and methods of curing ripe onions.
5. Describe the grading of onions.
6. Describe washing, bunching, and trimming of green onions.
7. How are they packed?
8. How are ripe onions loaded and shipped to market?

Harvesting.—Harvesting bulbs should begin as soon as maturity is indicated by the shriveling of the stems near the ground and a fair percentage of the tops have fallen. Loosening is not usually necessary on muck soils where most bulb onions are grown. On other soils the bulbs are loosened from the soil by a wheel hoe having two wheels straddling the row. A U-shaped cutter runs beneath the row. The bulbs are easily lifted by hand and laid on the bare soil to dry, the tops covering bulbs from alternate rows.

Green onions are pulled by hand when the soil is moist. If necessary, a wheel hoe is used to loosen them. They are placed in trays and taken to the shed for washing, bunching, and trimming. They are crated usually in shallow crates and strawberry carriers for shipment to market.

Curing.—The bulb crop must not be stored or put in large masses until thoroughly cured by drying in the open air. The bulbs are put in small flat windrows on the surface of the soil, and should be turned after each rain or oftener (Fig. 59).

Crate curing is practiced in some regions, especially in the more humid sections. Slatted trays four inches deep or bushel slatted crates are used for this purpose. At harvesting time these trays or crates are filled with bulbs from which the tops have

been removed by twisting a bunch at a time or, preferably, cut, leaving one inch of stem. The trays or crates are stacked one above another in the field or in a curing shed or similar building. If stacked in the field, the top crates are covered with boards or roofing paper to keep out rain. Bulbs may be topped during the curing period. Topping with shears is common in some regions. Bulbs are handled separately. This method adds greatly to the expense of the crop.

Grading usually follows the curing period. Onions are graded according to size and all culls are removed. Any which

FIG. 59.—Mature onions curing and ready to trim.

have started a second growth, developed sunscald, or have matured improperly are discarded. Only sound bulbs should be stored.

Seed crops are produced in dry regions where crops are grown under irrigation (Fig. 60).

Marketing.—In some regions onion associations are formed for marketing the crop. For the earliest crop both the green crop and the bulbs are marketed from the field as soon as possible. The price at that time is often very satisfactory and extra handling of the crop is avoided for all that can then be sold.

Job 9. Keeping Records

Onion records are kept on forms similar to those shown in the Melon Enterprise.

Onion Calculations.—1. How many onion sets are required to plant an acre, 43,560 sq. ft., if they are set for green onions 2 inches apart, in rows 1 foot apart? If they are set for ripe onions 4 inches apart, in rows 1½ feet apart?

2. How many bushels will be required in each case (problem 1) if there are 80 to the quart? If there are 100 to the quart?

3. If 500 bushels of onion bulbs remove from the soil 60 lbs. nitrogen, 25 lbs. phosphoric acid, and 60 lbs. potash, how much sulfate of ammonia testing 20% nitrogen will be needed to supply the nitrogen?

FIG. 60.—Blossom stage of onion crop grown for seed. A Texas scene.

4. How much 16% superphosphate will be needed to supply the phosphoric acid in problem 3?

5. How much muriate of potash testing 50% potash will be needed to supply the potash in problem 3?

6. How much will the "transplant" onions for an acre of green onions cost at $2.25 per thousand if they are to be set at 2-inch intervals in rows 1 foot apart?

7. A student grows early onions and secures an average gross income of $3.00 per 100 pounds for his entire marketable crop of 10 acres yielding 460 bushels of 56 pounds per bushel. Find his total receipts.

8. Another grower with a later variety receives $2.00 per 100 pounds but has a 10% larger yield. What is his income? Find the difference in percentage of money returns due to the later variety.

9. If Texas has annual car-lot shipments, over a series of years, of 4,283 cars of onions, and California ships 3,645 cars, by what percentage does Texas exceed California?

Green Manure

Produces humus
May add nitrogen
Unlocks plant food
Is cheapest plant food
Improves soil structure
Airs and warms soil
Regulates moisture
Retards leaching
Reduces washing
Favors soil organisms

ASPARAGUS ENTERPRISES

Collaborators: E. H. Rawl, M.S., Horticulturist, L. and N. Ry., Montgomery, Ala., and John Miley, Teacher of Agriculture, Williston, S. C.

Like the onion, asparagus is a member of the lily family. The plant is native to Europe and Asia and has been cultivated since before the Christian era. The Greeks are reported to have prized this vegetable for its medicinal qualities as well as for food.

Asparagus is widely grown in the United States, both for fresh market and for processing. It is available in quantity on our fresh markets from late winter through the summer months.

Analysis into Jobs.—The following jobs include the leading farm units in an asparagus enterprise. See special vegetable books listed in the Appendix; also *Asparagus Production,* by James and Robbins (Judd). Obtain station publications from California, South Carolina, Florida, and other states, and U. S. Farmers' Bulletin.

Job 1. Determining Possibilities with Asparagus

Conditions Usually Found.—Asparagus is grown in almost every state as a special crop for market or for home use.

Aims.—All factors involved in success with asparagus should be carefully considered before undertaking the enterprise.

Problems for Study and Discussion

1. Determine where asparagus may be grown.
2. To what extent is asparagus grown for market in your region?
3. What yields may be expected per acre?
4. How much time should elapse after planting crowns before asparagus reaches profitable cutting age?
5. How long is one planting normally profitable?
6. What is the cost per acre of growing asparagus?
7. Determine what prices are usually received.
8. What are the labor requirements with asparagus?
9. In what markets would a local crop be sold?

Where Asparagus May be Grown.—Asparagus growing is increasing and pushing into new fields each year. This crop

may be grown in practically all sections of the United States where soil conditions are favorable. In parts of states having the mildest winters, asparagus is an irregular bearer—fair crops usually following winters of sufficiently low temperature to give the necessary rest period.

The value of the commercial crop of asparagus in the six leading states in 1944 was as follows:

New Jersey	$6,850,000
California	6,323,000
Washington	2,860,000
Illinois	1,464,000
Michigan	1,140,000
Pennsylvania	893,000

Yields and Prices.—The yields per acre for states growing early asparagus vary from 40 to 140 crates per acre with an average of about 85 crates per acre. For all asparagus-growing states the average yield was recently about 97 crates per acre. Commercially grown asparagus consumed as a fresh vegetable as recently reported for one year was as follows:

States	*Acreage*	*Total Crates*	*Price per Crate*
EARLY ASPARAGUS			
California	24,400	2,342,000	$2.70
Washington	9,300	1,395,000	2.05
South Carolina	6,700	281,000	3.00
Other States	1,380	89,000	2.56
LATE ASPARAGUS			
New Jersey	22,500	3,262,000	$2.10
Illinois	8,500	774,000	2.10
Michigan	4,450	556,000	2.05
Pennsylvania	2,350	235,000	3.80
Maryland	2,100	252,000	2.90
Massachusetts	1,750	140,000	3.40
Delaware	1,650	182,000	2.65
Iowa	500	38,000	2.25

The prices for the early asparagus averaged $2.50 a crate, while the late crop brought on average of $2.26 a crate.

Bearing Age.—Some growers agree that a planting should pay for itself, including expenses from the time of planting, by the end of the fifth year if properly handled. The first important cutting year should be the beginning of the third season from the time of transplanting the crowns. During the second season, if it be done at all, cutting should be for only a very

short time. Cutting too early causes a severe drain on the root system and results in decreased yields in future years.

Duration.—The duration of a plantation depends upon preparation of soil, distance and depth of setting, annual tillage, fertilizing, and other care. Successful growers in some regions have profitably cut from the same setting for fifteen or twenty years. However, the average life of a plantation is more commonly ten to twelve years.

Cost of Growing an Acre.—The following represents a fair and reasonably accurate cost per acre for the various operations:

Soil preparation	\$15.00 to \$18.00
Setting crowns	25.00 to 30.00
Fertilizer (1 ton 5-7-5)	35.00 to 40.00
Side dressing (200 lbs.)	6.00 to 7.00
Cultivation	20.00 to 30.00
Harvesting, grading, and packing	.80 per crate

Labor Requirements.—Asparagus growing fits well into a cropping program which supplies or makes possible part-time labor, since the labor necessary in harvesting is not at all times fully occupied. An excess of labor must be ready for cutting. In sections, asparagus growing seems to combine well with dairy farming, and with peach and pecan growing. Avoid conflicts with strawberry growing or other crops demanding attention at asparagus-cutting time.

Job 2. Choosing the Variety

Conditions Usually Found.—Any variety grown in the home gardens is considered satisfactory if resistant to rust. In commercial sections great care is used in the selection of a strain or variety, and the commercially popular variety is used.

Aims.—The reasons for selecting and how to select the best strains or varieties of asparagus should be understood.

Problems for Study and Discussion

1. Determine the strains of asparagus grown in your section.
2. Report opinions of growers regarding different strains or varieties.
3. What is responsible for the two types of market asparagus?
4. Compare these two types in quality, appearance, and yields.
5. Which type of asparagus do your markets demand?
6. What is meant by a rust-resistant variety?
7. To what extent is the rust disease injurious to asparagus locally?
8. What variety is considered most resistant to this disease?

Activities.—Collect and compare the different types, varieties, and strains.

Two Types of Asparagus.—The white "grass" is made so by the depth of the crowns below the surface. Soil excludes light and prevents the development of chlorophyll or green color. In other words, asparagus of the Mary Washington strain may be either green or white (unblanched or blanched). The green "grass" is usually cut only a few inches below the surface; the white is cut just as the tips are appearing through the surface, and cut about nine inches in length.

Commercial Varieties.—The old varieties, as Palmetto, Reading Giant, and Argenteul, which are susceptible to rust and are of inferior quality, should never be planted. The strains of the Washington variety are the best for commercial planting. The Mary Washington strain is used because of being resistant to rust. Popular strains, made so by reason of vigor and resistance to rust, are of greater importance than older varieties.

Job 3. Selecting the Soil and the Field

Conditions Usually Found.—Asparagus is grown on a variety of soils from the very lightest to the heaviest types. In home gardens, convenience of location is considered instead of soil. Commercial plantings are usually grown under favorable soil conditions.

Aims.—The requirements for, the best results, and the reasons in selecting soils and locations for asparagus should be understood.

Problems for Study and Discussion

1. Inquire of neighbors and determine the soil conditions under which asparagus is being grown.
2. What types of soil are best for asparagus?
3. Compare heavy and light soils for earliness of crops; for green and for white asparagus.
4. Discuss drainage and depth of water table.
5. Compare northern and southern slopes for early crops of asparagus.
6. How much importance should be given to distance from the loading point?
7. After what field crop would you prefer to set a commercial asparagus field?
8. Discuss the need of having plenty of organic matter in the soil.
9. What cropping plan would supply organic matter for the soil?

Locating the Field.—Quality in cut asparagus is quickly lost. Therefore, the distance from the loading point must not be too great. Good roads and rapid transportation are essential. Ideal conditions would have the packing shed located at the shipping track; but this condition is seldom if ever found, as growers usually load with others at a neighboring station. A

southern slope is desirable for early crops. Protection from cold winds is advisable.

Choosing Soil for Asparagus.—This crop thrives on a variety of soils, grading from light sand to muck. A deep sandy loam soil underlaid with a clay subsoil is the choice of the majority of successful growers. California asparagus growers produce excellent crops on muck soil.

Light and loose soils are best for the production of early asparagus. Heavy and poorly prepared soils often cause crooked and low-grade spears. This is worse for green than for white asparagus.

The soil should be well drained but not "thirsty." The depth of the water table for best growth cannot be determined for all soils. Soils should be moist but not soggy.

Freedom from Weeds.—Clean cultivation of soil for a year preceding the setting of asparagus aids in killing weeds and grass. Weed seeds will be sprouted and killed. Another plan is to choke out weeds by growing a dense cover crop, as cowpeas or soybeans. This plan may serve to supply organic matter for the soil.

Organic Matter.—Before planting asparagus the soil should be supplied with plenty of organic matter. This may be done by using an abundance of well-rotted barnyard manure. A more economical plan is to turn under a dense growth of cowpeas or soybeans as green manure. A sod from pasture grass or the growth of any winter cover crop is suitable for asparagus soil.

Size of Field.—Commercial growers should grow areas small enough so that the best care can be given the plantation. It is best to begin with a small area and increase the size later if desired.

Job 4. Obtaining Seed; Testing and Treating

Conditions Usually Found.—Growers with experience in plant growing frequently grow the necessary plants. Seed is usually obtained from reliable local growers or from seed houses. As a general practice, seed is not tested nor treated by the growers.

Aims.—The importance of having good seed, how to secure it, and methods of treating and testing seed should be understood.

Problems for Study and Discussion

1. Compare prices and qualities of asparagus seed described in catalogs.
2. How much seed should be used per acre and how many crowns will be produced?

3. How should asparagus seed be tested for germination?
4. What percentage of germination should be required for good seed?
5. How many seeds per pound?
6. Calculate the number of plants produced per pound of seed.
7. Give reasons for treating seed before planting.
8. Give methods of treating seed.

Sources of Good Seed.—Good asparagus seed may be secured from reliable growers and from previously established fields of known productivity. Seed should have these characteristics: (1) viability, (2) freedom from weed seed and foreign matter, (3) trueness to type and unmixed, (4) freedom from disease, and (5) a good type and variety. There are many reliable growers and seedsmen handling asparagus seed. Obtain their names from growers, from agricultural journals, and from agricultural workers. Send for their catalogs. Compare prices and descriptions. Plant only the very best of seed obtainable.

Buying Enough Seed.—Usually three pounds of good seed is sufficient for seeding one acre for horse cultivation. If properly handled, one acre should produce 25,000 to 30,000 crowns. One pound of good seed properly planted and grown should give 5,000 to 6,000 plants, which will be sufficient for setting one acre, allowing sufficient surplus to make careful selection at transplanting time.

Testing Seed.—One of the several standard methods, as the rag-doll, may be used in testing seed and should germinate 90 per cent or above. Asparagus seeds germinate slowly; therefore, testing by indoor conditions may not serve as a safe guide by which to judge the actual plant-producing value when planted under field conditions.

Treating Seed.—Ordinarily asparagus seeds are not treated for disease control but rather to hasten germination. Under good conditions, two to six weeks from the time of planting is necessary before plants appear above the ground. Special methods are followed to reduce the injurious effects of weeds and grass choking out the small seedlings. Planting quickly germinating seeds such as radish and turnips with the asparagus will break the crust and mark the rows for early tillage.

Better germination is obtained by soaking seeds three days at a temperature of 86 to 95 degrees F. Another plan is to soak the seeds the last hour before planting in one-fourth of one per cent

semesan water solution. (See Appendix.) Immediately following soaking, the seeds should be spread on a cloth for an hour or so, to dry the surface, and should be planted before becoming entirely dry. If the seeds are allowed to dry or are planted in dry soil the effects of soaking will be almost entirely lost. Soil should be watered in case of dry weather between the times of planting and germination.

Job 5. Preparing Soil for Seed and for Crowns

Conditions Usually Found.—Growers without experience usually do not prepare the soils well for seed-beds and for fields.

Aims.—The grower should appreciate the necessity for thorough preparation and know how to do this by best methods.

Problems for Study and Discussion

1. How is the soil prepared locally for growing asparagus crowns? For permanent setting of asparagus crowns?
2. What should be the cost per acre for preparing soil for growing plants? For permanent fields?
3. Give a list of tools to be used in preparing soil for asparagus seed-beds; for fields.
4. What crop would you grow to produce organic matter for asparagus soil?
5. When would you incorporate this growth with the soil? How?
6. When should soil be plowed if setting is to be done in the spring?
7. When should preparation of the soil be completed?
8. Outline a complete plan for preparing one acre for seeding asparagus; for setting plants in field.
9. Under what conditions would you use a plank drag on the surface?

Time and Depth of Plowing.—For best results, soil to be planted to asparagus should be first planted to a green manure crop and this crop well incorporated with the soil. Plowing should be deep and thorough and sufficiently long before needed to allow the organic matter fully to decompose, and the seed-bed to settle. Soil that is full of grass and weeds should be carefully handled so as not to allow the grass and weeds to grow in advance of the young seedlings in the seed-bed or in advance of the newly set plants.

Successful growers of asparagus recommend that asparagus soil be prepared in the same way as for other truck crops or for corn, but earlier. One disking and several harrowings a short while apart, before the seed is planted or the crowns set, is desired. Where seeds are to be sown, the soil may be planked to crush the clods and smooth the surface.

Forming the Rows.—A riding disk cultivator may be used to advantage in opening the rows for plants and for throwing soil over the set crowns (Fig. 61). It is better than the shovel plow. The disks can be adjusted for hilling or for throwing out the

FIG. 61.—Disk ridgers are useful in ridging the rows of asparagus before cutting season.

soil. If ridges are desired, one operation will form them, the height of the ridges being regulated by the size and setting of the disks.

Job 6. Growing Asparagus Plants

Conditions Usually Found.—This job is a difficult one, and inexperienced growers often fail in producing plants of good quality. Commercial growers often produce their own crowns successfully.

Aims.—The best practices for sowing seed and caring for young plants to obtain strong crowns should be well understood.

Problems for Study and Discussion

1. What methods of seeding are used in your community?
2. How many local asparagus growers produce their own crowns?

3. Determine the best and most economical method of seeding.
4. How can male and female plants be distinguished? When?
5. Which is preferred and why?
6. Consult growers of crowns regarding care of seedlings.
7. Compare their methods and degrees of success.
8. How may stunted or retarded growth be avoided?

Activities.—Students should grow at least a small area of asparagus plants.

Methods of Seeding.—Plant the seed on slight ridges with planters having special plates for spacing. Regulate the planter to drop one seed in a place so as to save hand thinning. Ideal

FIG. 62.—Field of young asparagus from seed. (T. R. Pender, Williston, S. C.)

planting would have the individual seeds spaced two to four inches apart and covered one and a half to three inches in muck soil or similar organic soil. Seed planted several in a hill result in low-grade plants. The fleshy roots of the several plants become entangled, resulting in all plants being poor. If hand-wheel hoes are to be used between rows, the space for tillage should be about eighteen inches. For horse tillage, thirty-six inches is common.

Cultivating Young Plants.—Keep the plants growing well (Fig. 62). Allow no weeds among them. Some hand labor is often necessary. A small cultivator is satisfactory for such small plants.

Fertilizing Young Plants.—Successful growers, operating on light sandy loam soil, use 800 to 1,000 pounds per acre of a fertilizer analyzing 5-7-5 (N-P-K). This application is made under the ridge or row. About 400 to 600 pounds per acre of nitrate of soda, applied in three applications, is given as a side dressing to young plants the first year. Application should begin early.

Selecting the Male Plants.—Experimental evidence shows that male or staminate plants produce larger shoots and a 25 to 50 per cent heavier yield than female or seed-bearing plants. The two types cannot be accurately separated, until the berries have formed, which may take place the second year. This late choosing necessitates the transplanting of two-year-old crowns. Growers differ as to the value of delaying the planting just to separate the male and female plants. One-year-old crowns are, therefore, often used.

Sorting Crowns.—Large, well-grown, one-year-old crowns should be selected when crowns are dug and sorted for planting. The best crowns have good body, plenty of roots, and several buds.

Job 7. Setting Crowns in the Field

Conditions Usually Found.—One-year-old crowns are preferred to older ones for planting. All weak crowns are usually discarded.

Aims.—The requirements for good crowns and how to set them well and economically should be understood.

Problems for Study and Discussion

1. Where may crowns be purchased?
2. Compare the prices per thousand at which crowns are offered.
3. Determine the number of crowns needed per acre at various planting distances.
4. Determine the sizes and ages of crowns used in your section by best growers.
5. Determine the depth at which crowns should be set.
6. Find out from growers what time of the year is preferred for setting asparagus crowns.
7. Compare effects of three methods of setting: (a) shallow setting and immediate covering; (b) deep setting and immediate covering; (c) deep setting and gradual covering during the process of cultivation.
8. Report the common practices used in asparagus planting in your section.

Activities.—Set crowns by different methods and compare results.

Buying Plants.—Crowns for planting may be purchased from reliable growers and dealers. Obtain addresses of outstanding

and successful asparagus crown growers in the South by asking agricultural workers. It is possible to obtain crowns through reliable seed houses. If crowns are purchased, be certain that they were produced from the very best of seed from rust-resistant stock.

Prices of crowns vary with the size of the order and the quality of the crowns. The range is from $2.50 to $20 per thousand. Quality should be the deciding point since poor crowns and plants are always expensive in the end. From 3,000 to 4,500 crowns are needed per acre. This depends upon the planting distances and quality of the crowns (Fig. 63).

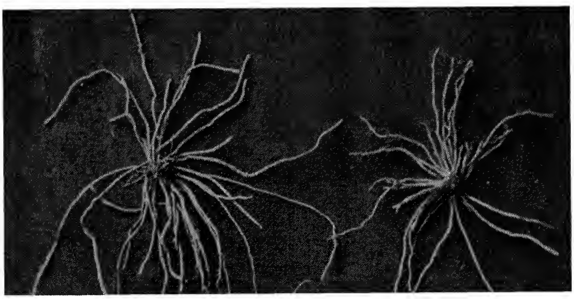


FIG. 63.—Good yearling crowns of asparagus. (T. R. Pender, Williston, S. C.)

The spacing between rows is six to eight feet for white asparagus, and four to six feet for green asparagus. The wider spacing makes ridging possible, which is necessary in the growing of white or blanched asparagus. Crowns are set at intervals of eighteen to thirty inches in the rows. This is for both white and for green asparagus.

Methods and Depths of Setting Crowns.—The crowns should be planted with their buds six to eight inches below the level of the surface. On heavy soils the depth is less. Planting depth bears a direct relation to the cutting method, to the life of the plants, and to methods of cultivation. The crowns develop some higher each year, and unless deep planting is practiced, satisfactory cultivation and maximum production should not be expected.

Deep planting followed by complete covering endangers the life of the plant by smothering. The crowns should be well

placed, eighteen to twenty-four inches apart, in deep, broad-bottom furrows and should be covered immediately to only a part of the depth, about two to three inches. Soil should be moved toward the rows as growth develops and cultivation requires until the furrows have been gradually filled. Beginners should never make the mistake of filling furrows completely, immediately after planting crowns.

Winter Setting.—After summer growth is over, the dead tops should be mowed and raked away from the nursery rows. The crowns are lifted with a plow and sorted. The strong crowns may be set any time during the dormant period, between late fall and early spring. Setting should always be done before spring growth begins.

Job 8. Providing Manures and Fertilizers

Conditions Usually Found.—Experienced growers usually have a planned program for using fertilizers. Growers of little or no experience follow recommendations of experiment stations. Factory-mixed fertilizers are usually used. In some cases, home-mixed fertilizers are used.

Aims.—The best formulas, the best carriers, rates of application, method of applying, and times of applying fertilizers should be understood.

Problems for Study and Discussion

1. Inquire locally regarding the fertilizing practices of the best growers.
2. What local practices could be improved with profit? How?
3. Give opinions of best growers as to the value of organic matter for asparagus.
4. What is the experimental evidence as to the value of organic matter?
5. What organic sources and what green manuring crops are used by local growers?
6. What plant food elements are needed for asparagus?
7. What organic fertilizers can be purchased?
8. What mineral fertilizers would you buy?
9. Determine the cost per acre for fertilizing asparagus in your section.
10. Find what ready-mixed fertilizers are used on asparagus in your section, and learn the cost of each.
11. How many growers of asparagus in your section mix fertilizers?
12. What materials are used?
13. Discuss times, rates, and methods of applying fertilizers.
14. Debate: Home-mixed vs. ready-mixed fertilizers.

Activities.—Practice mixing fertilizers for asparagus.

Organic matter is considered by many successful growers to be essential if soils are light. In sections where moisture shortage is a factor and asparagus is grown on light porous soils, organic matter increases the water-holding capacity and plant-food

content. Experimental trials indicate that heavy applications of barnyard manure are not essential if the tops and intercrops are worked into the soils.

The kind and amount of fertilizer to use depends almost entirely upon the condition and type of soil. A mixture analyzing 4 or 5 per cent nitrogen, 7 or 8 per cent phosphoric acid, and 4 or 5 per cent potash may be applied at the rate of one ton to the acre. This may be followed with a side dressing of 200

FIG. 64.—Ridged rows fertilized with a ton of 7-5-5 (N-P-K) fertilizer and 800 pounds of sulfate of ammonia per acre. Rye is grown in winter between rows, serving as a cover crop and windbreak. (Q. A. Kennedy, Williston, S. C.)

pounds of nitrate of soda or sulfate of ammonia, and with 200 pounds of muriate of potash per acre (Fig. 64).

Time and Method of Application.—Fertilizer is usually broadcast a short time before cutting begins, but recent tests indicate that better results are obtained when applied immediately after the cutting season is over. The nitrate of soda or sulfate of ammonia is applied after the cultivation has begun. This side dressing may be applied with a one-row distributor or by an attachment on a riding cultivator.

Job 9. Cultivating Asparagus

Conditions Usually Found.—The cultural practices are about the same with all asparagus growers of experience. Companion crops, cover crops, and clean cultivation are used. Some growers cut tops too early instead of waiting until after they die.

Aims.—The best methods of cultivating and growing of companion crops and cover crops, and the working in of asparagus tops and other green manure should be understood.

Problems for Study and Discussion

1. Outline the best and most economical cultural program of local growers.
2. Compare cultural practices of asparagus growers elsewhere.
3. Why should a grower not cut his asparagus tops when green?
4. Compare cultural practices for green and for white asparagus.
5. What are the steps in tillage of asparagus the second spring?
6. During what year or years of an asparagus bed would you grow a companion crop?
7. Make a list of good crops suitable for this purpose.
8. Outline the program for growth and management of one of the best companion crops.
9. Describe a good place for cutting and plowing in asparagus tops.
10. When should the winter cover crop be sown?
11. What crop or crops would you sow?
12. When is this turned under?
13. Outline a good cultural program for each summer in an old field after the cutting season is over.

Activities.—Overhaul cultivators and tools for this job. Practice different methods of culture and compare results.

Companion Cropping.—An intercrop not too tall nor too late in growth should be grown between asparagus rows the first season, and some growers do this the second season. The intercrop should yield enough to help pay for the cost of the asparagus field. Its tillage should also suit the growth of the asparagus. Suitable crops would be early potatoes, early cabbage, lettuce, bush beans, and others. One row of intercrop is usually enough in each middle. Sometimes a light stand of cowpeas is grown between rows during the summer and worked into the soil with the asparagus tops.

Clean Cultivation.—Plant growth should be stimulated by clean tillage each season. The next crop of shoots depends upon this. Keep down weeds and grass by horse tillage and by such hand hoeing as may be needed. The soil is worked level until the last cultivation each summer, when the rows are ridged three to five inches high. Cultivation ceases when the top growth shades the middles.

Managing Asparagus Tops.—The annual growth of tops after the cutting season gathers strength for the crowns for the next crop. The tops should not be cut before they die as such a practice would weaken the crowns and reduce the next crop.

Tops may be cut in fall when they die or may be left until very early spring. They may be removed with a cotton-stalk cutter and then disked into the soil or turned under with a turn-

ing plow run shallow. These implements may be used over the middles and rows at such a depth as not to injure the crowns. If this work is done in the fall a cover crop of rye and winter vetch should be sown. This is to hold the soil and plant food and to provide additional green manure. The winter growth should be disked under before other spring operations. The main application of fertilizer is also applied and disked in at this time.

Ridging Asparagus Rows.—Several types of ridging machines are in use. A common turning plow or disk plow may be used if desired. Ridging of rows is necessary when the white type of asparagus is produced to aid in properly blanching the product. For the green product only a slight ridge is desired. The first step, after stalks or the winter cover crops are removed or disked under, is to throw two furrows together. A few days before the cutting begins the ridges are completed by being made higher and wider, and then are left until harvest is over, when the ridges are worked down to a level again.

Job 10. Controlling Asparagus Enemies

Conditions Usually Found.—Asparagus rust and beetles are considered the most serious enemies. Experienced growers usually have little or no trouble in controlling asparagus enemies.

Aims.—Students should be able to identify the enemies of asparagus and know what measures are necessary for their control.

Problems for Study and Discussion

1. By local inquiry, determine the enemies of asparagus in your section.
2. Describe the control methods used by growers in your community.
3. Find whether or not rust is equally troublesome in all fields.
4. What strains of asparagus are most resistant to rust?
5. At what seasons do you find diseases and insects most prevalent?
6. What are the reasons for more rust in the older plantings of asparagus?
7. Outline the regions of infestation of asparagus enemies.
8. Describe the fighting of asparagus beetles.

The common asparagus beetle is blue-black with yellow markings. It is about one-fourth inch long. It feeds on the shoots and tops both in the larva and in the adult stages. It is held in check by clean-up measures each year, by cutting crop clean and removing volunteer plants, and by dusting at the end of the cutting season with arsenate of lead. Keeping poultry in the asparagus will help.

The twelve-spotted beetle is of red-orange color with six black spots on each wing. It has a much broader back than the common asparagus beetle. It feeds in the adult stage mainly upon the young shoots and eats on the berries. It is held in check as recommended for the common asparagus beetle.

The asparagus miner is a metal-black fly, about one-sixth inch long. It feeds in the larva stage on the stalks near the ground. It is held in check by clean-up measures, and by the use of syrup-sweetened arsenical sprays.

The garden centipede is small and almost transparent. It feeds in the adult stage on the shoots even below the surface. The best known method of control is to flood the soil for a period of from one to three weeks.

Asparagus rust is a fungous disease living over winter in the soil and on old stalks of asparagus. In the early stages, asparagus rust appears as reddish or orange-yellow spots on the main stems and branches. In the later stages the entire plant is affected. The damages resulting from asparagus rust are weak growth, reduced top growth, absence of stored food, and greatly reduced crop yields. The use of rust-resistant strains such as Mary Washington is the best prevention of rust. Clean-up measures are practical, but may never eradicate the disease with common varieties.

Job 11. Harvesting, Grading, and Packing

Conditions Usually Found.—Experienced growers who are well organized succeed well in their harvesting, grading, and packing of asparagus. Others often fail to reach the markets with the product in the best condition, and fail to command the best prices.

Aims.—Growers should understand and be able to practice the best methods in harvesting, grading, and packing asparagus.

Problems for Study and Discussion

1. Compare prices received by growers using the best and those using poor methods of harvesting, grading, and packing.
2. When does the asparagus harvest begin and end?
3. Describe good cutting tools.
4. How often should each row be cut?
5. Give directions for cutting green asparagus. What lengths are wanted?
6. Give directions for cutting white asparagus.
7. How many growers in your community wash asparagus?
8. Describe facilities for and methods of washing.
9. What grades are used in packing asparagus?
10. When and how should grading be done?
11. Describe the methods of bunching asparagus.

12. What is the cost of a good buncher?
13. What are the lengths and weights of bunches?
14. Where are crates secured? Give sizes and costs.
15. How is asparagus packed in crates?

Activities.—Practice harvesting, grading, and packing asparagus for market. Determine the time requirements and costs for each of these operations. Make a bunching machine, cutting knives, and pyramid crates.

Time to Harvest.—Cutting should begin as soon as shoots appear of proper length and size (Fig. 65). Young beds should be cut for only a short time. Old beds may be cut for six or eight weeks. Cutting should stop as shoots become slender. A late, cold spring makes a late and prolonged cutting season for the asparagus grower. This may result in loss because of market conflicts. Daily cuttings should be made on every row (Fig. 66). In warm weather white asparagus is cut oftener.

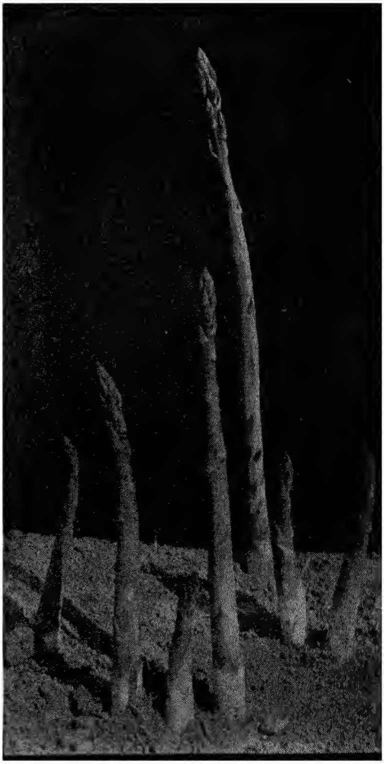


Fig. 65.—Shoots of green asparagus ready to be harvested. (Seaboard A. L. Ry.)

Cutting Knives.—A long blade, sharpened at the square or rounded end, is needed. Some forms of butcher knives or thin chisels will serve the purpose well. A home-made cutter may be made from an automobile spring blade.

Methods of Harvesting.—Green asparagus is cut when five inches high and is cut four inches below the surface. White asparagus is cut when the shoots are first seen by cutting eight or nine inches below the surface. Splint baskets or lug crates are used to gather and transport the cuttings from the field to the packing house. Each person can cut two rows at a time. The shoot is held in

one hand and the knife is pushed down to the proper depth to make the cut without injury to the crown and other shoots. The baskets or lugs of shoots should not be exposed long to sun or wind. They must be hauled soon to the packing shed.

Washing Asparagus.—If soil is black or sticky or if spray materials are on the shoots the cuttings will need washing. Where washing is done, brushes, wire baskets, or wire-bottom trays, and benches should be provided so as to permit drying of the shoots. Any shed having sufficient space, light, and water

FIG. 66.—Ridged rows of asparagus. Harvesting white shoots when they are up enough to be seen. (T. R. Pender, Williston, S. C.)

will serve as a packing and washing place. However, never wash asparagus unless it is necessary.

Grades.—The U. S. Department of Agriculture suggests two grades for asparagus, as follows:

U. S. No. 1 shall consist of stalks of asparagus which are fresh, well trimmed, and fairly straight; which are free from decay and from damage caused by spreading or broken tips, dirt, disease, insects or mechanical or other means. *Unless otherwise specified* each stalk shall have a diameter of not less than one-half inch, and not less than two-thirds of the stalk length shall be of a green color.

In order to allow for variations incident to proper grading, not more than ten per cent, by count, of the stalks in any container may be below the requirements of the grade, but not more than one-half of this tolerance, or five per cent, shall be allowed for defects causing serious damage, and not more than one-fifth of this amount, or one per cent, shall be allowed for decay. In addition, not more than ten per cent may be below the required or otherwise specified minimum diameter.

U. S. No. 2 shall consist of stalks of asparagus which are fresh, fairly well trimmed, and not badly misshapen; which are free from decay and from serious damage caused by spreading or broken tips, dirt, disease, insects, or mechanical or other means. *Unless otherwise specified* each stalk shall have a diameter of not less than five-sixteenths inch, and not less than one-half of the stalk length shall be of a green color. The

tolerance for defects is similar to that allowed under the U. S. No. 1 requirements.

Diameter.—The following terms are provided for describing the diameter of any lot:

Very small, less than $\frac{5}{16}$ inch;
Small, $\frac{5}{16}$ inch to less than $\frac{8}{16}$ inch;
Medium, $\frac{8}{16}$ inch to less than $\frac{11}{16}$ inch;
Large, $\frac{11}{16}$ inch to less than $\frac{14}{16}$ inch;
Very large, $\frac{14}{16}$ inch and up.

Green color.—When the stalk has less or more green color than is specified in the grade, it may be described as ¼ green, ¾ green, etc., in accordance with the facts.

Bunching Asparagus.—The bunch is the unit package usually sold. For best returns, it must be made up of well-

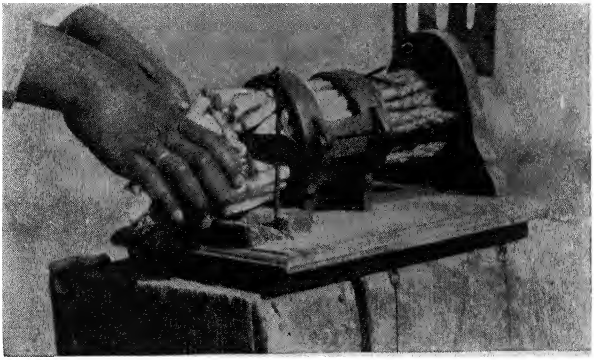


Fig. 67.—Using bunching form and trimming knife. (John Miley, S. C.)

graded and selected stalks and these must be well bunched. The standard size of bunch requires about twenty-eight inches of tape or raffia, is eight and one-half inches long, and weighs about two pounds. The number of stalks in a bunch varies with the three grades. The shoots are placed in a buncher with all heads in one direction and well against the head board. Ties are securely made, one at each end, red or blue tape being most popular. Before the buncher clamps are removed, the butts are trimmed (Fig. 67). The finished bunch length is eight and one-half inches.

The bunches are separated according to grades. If necessary temporarily to delay packing, bunches may be set upright on layers of wet moss or in shallow pans in which there is about an inch of water.

Asparagus Crates.—In the South and Southeast pyramidal crates similar to those used in California are often used. The New Jersey and the Illinois crates differ from these. The inside measurements of a pyramidal crate are $10\frac{1}{2}$ inches deep, 17 $\frac{13}{16}$ inches long, 11 inches wide at the bottom, and $9\frac{1}{2}$ inches wide at the top. The crate is made in two compartments (Fig. 68).

Packing Asparagus.—The bottom of the crate is usually lined

FIG. 68.—Trimming by hand, and packing asparagus. (T. R. Pender, Williston, S. C.)

with a sheet of oiled paper, which is cut about one inch larger than the bottom of the crate, and the edges are turned up. A layer of about one and one-half inches of wet sphagnum moss is placed on the oiled paper, making the crate ready for receiving the asparagus. Some growers use moss without the paper, but the added cost of the paper is justified. Bunches are packed from the side of the crate with butts on the wet moss. There are twelve to the crate, packed tight.

Job 12. Marketing Asparagus

Conditions Usually Found.—Asparagus is sold both locally and on distant markets. The distant markets are usually supplied through more or less well-organized marketing channels.

Aims.—The requirements for and methods of marketing asparagus, including transportation, selling separately and coöperatively, and making consignments successfully, should be understood.

Problems for Study and Discussion

1. Determine where asparagus is grown in your section.
2. Where and when is the asparagus crop of your section marketed?
3. What sections compete with your section in the markets?
4. Study the comparative returns from local and from distant sales.
5. Give arguments for each of these plans of selling.
6. What is the cost per crate of marketing asparagus, including (a) cutting, (b) packing, (c) transportation, and (d) commission?
7. Compare the returns from sales made through consignments and through associations.
8. Give the advantages to local growers which may result from pooling shipments.
9. How much of the local crop is shipped by express?
10. Discuss the value of a cannery for your region.

Activities.—In markets study the types, sources, and styles of packing.

Methods of Shipping.—In small quantities and for short distances, asparagus is often transported by truck. Distant shipments are made by express and by fast freight. Refrigerated cars for car-lot shipments are necessary for good results. Several growers may combine in loading a car. Cars are often loaded in less time by being stopped for part loading at several neighboring stations. Loading must be done as rapidly as possible, as asparagus loses its quality very rapidly.

Loading Crates into Cars.—As cars vary in length and crates are not all standard, several plans of loading cars are seen. Crates are placed so that the shoots are upright; eight crates fit across the car; inch strips are nailed to each cross-row of crates to hold them in place and allow ventilation and refrigeration circulation. Crates are packed three deep without strips between layers. With most refrigerator cars 160 crates may be packed and nailed in each layer, or 480 crates in a car.

Market conflicts depend to a great extent on the weather and management by the grower. Some years a late spring prolongs the cutting of asparagus, and other crops come on the market at the same time. The shipping season usually extends over a period of six to eight weeks. Crop conflicts should be avoided as far as possible by growing such crops as will be ready for market at other times than during the asparagus-harvesting period.

Asparagus Shipping Seasons.—Market prices are often influenced by shipments from competing sections. The following

shipping dates prepared by the U. S. Bureau of Agricultural Economists give the ranges for a ten-year record:

South Carolina,	March to May
Georgia,	March to May
Illinois,	April to June
New Jersey,	April to July
Oregon,	April to May
Washington,	April to June
Delaware,	May to June
California,	February to June

Methods of Marketing.—Asparagus can be marketed either fresh or canned. The crop of fresh asparagus of small growers is sold with other growers by pooling shipments or through local associations. Sales are made direct to dealers, to jobbers, or to local buyers at the tracks. Much is sold through commission firms. Neighboring and local markets consume daily truck shipments in irregular quantities.

Canning of asparagus has not been very extensive in southern regions as the early crop sells better as a fresh product. Broken markets and prolonged cutting seasons sometimes necessitate canning.

Job 13. Keeping Records

Special Asparagus Records.—The necessary cost accounts, sales accounts, and summary records should be kept on forms similar to those given in the Melon Enterprise. Besides these the grower should keep special asparagus records of trials conducted to show different rates of fertilizing, selling in different markets, different types of products, etc.

Market Calculations.—1. A farmer paid $66 taxes on an asparagus field containing 75 acres. If the tax rate is 22 mills, what is the assessed valuation per acre for his land?

2. What should the land bring in rent in order to pay the taxes and give the owner an 8% income from his investment, provided the valuation for taxes is one-half the actual value?

3. How many asparagus crowns are needed for an acre if the rows are 5 feet apart and the crowns set every 18 inches in the rows?

4. Find the local price for asparagus crowns and determine the cost for an acre set at the distances indicated in problem 3. What would be the cost of these plants at $12 a thousand?

5. Determine the cost of 1,500 pounds of a 5-8-5 (N-P-K) fertilizer for an acre of asparagus if made from nitrate of soda containing 16% nitrogen and costing $60 a ton; muriate of potash containing 48% potash and costing $45 a ton; and 16% superphosphate, costing $18 a ton.

MELON ENTERPRISES

Collaborator: J. G. Woodroof, Ph.D., Formerly Professor of Horticulture, Georgia Experiment Station.

Melons, cucumbers, squash, and pumpkins are hot weather crops. They are grown over a wide range of soil types and under varying climatic conditions, but melons and cucumbers, in particular, are especially adapted to the higher average temperatures of the South and Southwest.

The watermelon is a native of Africa, where it has been cultivated since antiquity. Muskmelons and cucumbers originated in Asia. Cucumbers have been cultivated in India for three thousand years or more and in Europe since the sixteenth century. The most common types of squash apparently have developed from a plant native to the American Tropics, although at least one type apparently originated in Asia.

Analysis into Jobs.—The melon group includes watermelons, cantaloupes, cucumbers, squash, and pumpkins. The farm units and jobs in each enterprise with this group are given below.

Job 1. Determining the Possibilities with Melons

Conditions Usually Found.—The melon crops are grown for commercial purposes in many sections of the southern states. Experienced growers seldom fail to produce good yields, but many are discouraged by unsatisfactory market conditions.

Aims.—Growers should take into consideration the factors of soil, climate, shipping conditions, available markets, probable yields, and returns in deciding on whether or not to grow the melon crops.

Problems for Study and Discussion

1. To what extent are the melon crops grown in your community?
2. How many of the growers consider local soils and climate suitable for both types of melons?
3. What is the average yield to expect in your community?
4. What is the average price received during the past five years by the growers in your community?
5. What is the average cost per acre to grow one of these crops?

6. What serious troubles are growers having in your community in producing and marketing the melon crop?
7. What are the shipping facilities for handling your crop?
8. To what markets would your crop be sent?

Activities.—Get production and price data from the last U. S. Yearbook. Compare the last three years with the preceding three years to show the trends.

Where Melons are Grown Commercially.—The melon crop may be grown for home consumption in practically all sections of the United States. For commercial purposes, however, the areas are more limited.

The leading states in order of production of watermelons are as follows: Georgia, California, Florida, Texas, South Carolina, Missouri, Alabama, and North Carolina.

Cantaloupes are grown in many of the southern states. The leading states in the country are as follows (in order of production): California, Arizona, Maryland, Indiana, Michigan, Colorado, Delaware, North Carolina, Texas, New Jersey, and Georgia.

The leading states for shipping the early crop of slicing cucumbers to market are arranged in order of production: New York, Florida, New Jersey, California, Maryland, and South Carolina.

Massachusetts and California are leading states in the production of squash, although practically all of the southern states grow some squash for market. Pumpkins are grown in fields with corn or alone, quite commonly in all states.

Climate.—Early crops of this group from the southern states reach the markets ahead of late crops produced farther north. The warm southern climate is very favorable for the production of melons and cucumbers. Southern growers thus have a decided advantage with production and marketing of watermelons. This is true to a less degree with cantaloupes.

Cost of Growing Melons.—The growing of an acre of melons will vary in cost from one section to another and for different years. Such factors as the rent of land, the price paid for labor, the amount of fertilizer used, the weather conditions, etc., all cause the cost to vary. It is hard to give exact figures which apply to all sections of the southern states. The cost per acre should not be more than $65 to $120, and in many cases less.

Yields to Expect per Acre.—On the same farm the yield per acre may vary from year to year. Soil conditions, weather conditions, amount of fertilizer used, time of planting, and cultural methods all influence the yields. Growers usually plan to produce a car lot of watermelons on every two acres. The Georgia Station showed that the Stone Mountain variety for four years averaged 720 melons per acre; the Tom Watson averaged 542 the same years. Cucumbers produce from 200 to 300 crates per acre, cantaloupes from 100 to 200 standard crates, and squash from 150 to 300 crates.

Prices to Expect.—The melon crop varies in price each year, depending upon many factors of production and the ability of the buying public. Prices are usually high at the first of the season for any of the crops of this group. Later prices may be so low that even freight charges will be more than the shipment will bring on the market.

Labor Requirements.—The grower will usually have to plan to secure extra labor during the harvesting season for the melon crops. The melons have to be harvested at a specific time and enough labor must be available. The amount of labor required at harvesting is about equal to all of the other labor required in the production of the crops.

Job 2. Choosing the Crop and the Variety

Conditions Usually Found.—One section of the country usually specializes in growing one of the melon crops. Growers of one region usually select one or two standard varieties for shipping to market.

Aims.—Growers should know the best commercial varieties for each crop, and should know which crop is best suited to local conditions.

Problems for Study and Discussion

1. Which crop does best in your community?
2. After talking with the freight agent, give a record of the shipments made last year for each crop from your station.
3. What are the varieties found in your community for watermelons, cantaloupes, cucumbers, squash, and pumpkins?
4. Choose the best variety of each and give reasons for your choice.
5. What are the advantages of growing only one variety in a community?
6. Under what conditions would two varieties of melons be advisable?
7. Describe the qualities of a good watermelon for commercial purposes.
8. What are the characteristics of the best market cantaloupes?
9. Discuss varieties of cucumbers for pickling and for slicing.
10. Discuss disease-resistant varieties of melons.

Activities.—In markets, fields, and elsewhere practice identifying varieties of these crops.

Watermelon Varieties.—In order to be a good shipper, a watermelon should have a rather tough, thick rind, although some of the thin-rind melons are being packed in straw and shipped to market. Long melons will pack in a car better than round ones, wherever straw is not used. The leading commercial varieties and average weights are Tom Watson (26 lbs.); Irish Grey (23 lbs.); Excel; Florida Favorite (23 lbs.); and Stone Mountain (28 lbs.). The Stone Mountain variety can be shipped to market if it is packed in straw. Dixie Queen is of high quality but it is said to be difficult to handle. About 110 days is required for maturing each of these mentioned.

Cucumber Varieties.—The Improved White Spine cucumber is probably the leading commercial variety for slicing. The Davis Perfect is used in some sections. It is similar to the White Spine, but is extra long, dark green, and holds color well. Cucumbers for pickling are usually grown under contract and the variety is specified to suit the type of pickles desired.

Cantaloupe Varieties.—The Rocky Ford is still one of the leading varieties. Other good varieties include Emerald Gem, Jenny Lind, Hearts of Gold, Pollock, and Pink Meat. All of these varieties are of the netted type. Deep, pronounced, fine netting is preferred. Lobing of the melon is not wanted. A new variety known as Honey Dew is now being grown in many places. Fruit of this variety contains no surface netting, the flesh is rather thick, and the texture and quality are very good.

Summer Squash Varieties.—The varieties of summer squash usually planted are the White Bush or Patty Pan (Fig. 69) and the Summer Yellow Crookneck. The former usually sells better in northern markets, but southern markets prefer the yellow squash. For the autumn or winter varieties the Hubbard, Boston Marrow, Winter Crookneck, and Marblehead are good for the market. Pie pumpkins are rich in flavor and are used in canneries and sold in markets.

Number of Varieties.—Communities which grow enough melons to attract buyers from a distance have much difficulty in selling their melons if more than one variety is grown. Buyers prefer to fill cars with one variety only. The first step in coöperative marketing is to standardize on one variety. Grading, packing, and selling are all easier. Sometimes two varieties are grown if one is very much earlier than the other.

Resistant Strains.—Where wilt disease is serious the best means of control is to select strains of melons which have resisted wilt and are believed to be resistant. It is not difficult when a field is attacked to select seeds from melons which have resisted and are proved to be resistant.

Job 3. Selecting the Field and the Soil

Conditions Usually Found.—Many growers select the wrong kind of soil for producing melons.

FIG. 69.—Early Summer squash of the "patty-pan" type finds a ready sale in northern markets beginning in May. (Seaboard A. L. Ry.)

Aims.—Growers should know the kind of soil best suited for growing melon crops, the proper location for the field, and the importance of selecting soil free from melon diseases.

Problems for Study and Discussion

1. What type of soil in your community is best for the melon crop?
2. Quote opinions of growers regarding different types of soil.
3. What rotation is practiced where melons are grown?
4. What is the reason for locating the melon field near the shipping point?
5. Compare the lengths of haul for several local growers.
6. What is the best size of field to use in planting the melon crop?

7. To what extent are growers increasing or decreasing their areas for melons? Explain if possible.

Activities.—Obtain several soils and test each for organic matter, by drying, weighing, and burning out humus.

Soils for Melons.—The kind of soil best adapted for the growing of the melon crop is a fertile, well-drained, sandy loam soil with a clay subsoil. Other types of soil may be used if they are fertile and well drained. The sandy loam soil has the advantage of warming up early in the spring.

Soil Rotation.—It is very essential that soils be selected which are free from disease. In many places the melon crop is grown on new land so as to be certain to avoid infected soil. Melons should be included in a rotation which takes at least five years for completion.

Location of the Field.—The melon crop is easily injured in hauling from the field to the shipping point. For this reason, the field for growing melons should be selected as near the shipping station as possible.

Protection from Wind.—Considerable damage is often done to the melon crop by high winds. If a windbreak is suitably located, grow the crop under its protection. Many farmers leave part of the trash on the top of the soil so that the vines will have less damage in the case of high winds. A rough surface prevents the movement of vines by the wind. A southern or a southeastern exposure is desirable.

Job 4. Obtaining Seed; Testing and Treating

Conditions Usually Found.—Growers are often careless in selecting good seed. Poor stands often occur on account of not testing the seed. Few growers treat the seed for diseases.

Aims.—(1) The student should understand the importance of good seed, (2) know how to test seed for vitality, and (3) know how to treat seed.

Problems for Study and Discussion

1. What methods are followed by the growers of your community in obtaining seed?
2. Debate: Saving seed vs. buying seed.
3. Describe the selection of melons for seed.
4. How long will melon seed retain vitality in storage?
5. How much seed is needed for planting an acre?
6. How would you test seed for vitality?
7. Explain how you would treat melon seed for disease.
8. What do we mean by pedigreed seed?

9. What is certified seed?
10. How could you develop melon seed which is wilt resistant?

Activities.—Practice field selection of seeds of these crops. Test and treat seeds for planting.

Sources of Seed.—Very few growers actually save their own seed but depend upon securing them from some seedsman. If the seed is saved on the farm, care should be taken in selecting only the very best melons from a patch that is true to type (Fig. 70).

Special care must be exercised in buying seed from a reliable seedsman. Do not purchase seed just because it is quoted at a

FIG. 70.—Good specimens of Tom Watson variety from which to save seed.

low price. Poor seed means a poor stand and weak plants, and in the long run a poor yield.

Melon seeds stored in a warm, moist climate will soon lose their vitality. They should be stored in a dry place and never kept over one season.

Amount of Seed to Buy.—In planting melons, it is best to plant more seed than is actually needed. This is done in order to allow for injury that may come from frost, insects, or diseases. Seed planted in the drill will take more than if the check system is used. It will usually take two or three pounds per acre.

Testing Seed.—In all cases seed should be tested before planting in order to tell how thickly to plant. The most practical way is to use the rag-doll method (U. S. Farmers' Bulletin 948). Tear strips of cloth about twelve inches wide and four or five feet long. Wet the cloth and spread it on a table. Count out a hundred seeds and place them evenly over the cloth. Then roll up the rag and place a rubber band around each end. Soak the doll in water for twelve hours and then keep it in a moist place at just as even a temperature as possible. After a few days, unroll the rag and count the number of seeds which have germinated.

How to Treat Seed.—Many diseases are carried by spores on the seed, especially those causing wilt and anthracnose. The spores stick to the seed and are active on the young plants.

The seed may be treated by using one-eighth of an ounce of bichloride of mercury (corrosive sublimate) in a gallon of water. Use a wooden pail for the solution. Let the seed remain in the solution for four or five minutes. This solution is very poisonous and should not be left where animals may drink it. Semesan is now considered a more satisfactory material for treating garden plantings. Use one-fourth of one per cent of water solution and soak the seeds in this for one hour.

Job 5. Procuring Plant Food; Applying Fertilizers

Conditions Usually Found.—Farmers usually buy some form of a complete commercial fertilizer for the melon crop. Few of them mix fertilizers at home, but nitrate of soda or other materials are applied without mixing.

Aims.—Growers should understand the plant food requirements of the melon crop, and should be able to supplement home-grown manures and to calculate fertilizer formulas for home mixing.

Problems for Study and Discussion

1. From what sources are the fertilizers secured in your community?
2. What kinds of commercial fertilizers are recommended for melons by your experiment station?
3. What influence have fertilizers on the quality of the melons produced?
4. Debate the use of barnyard manure for melons of different types.
5. To what extent is side dressing practiced in your community? What kind of fertilizer is used?
6. Give reasons for using unmixed fertilizers for melons.

Activities.—Run trials to test the value of organic matter in melon soils.

Barnyard manure is used sometimes as fertilizer for the melon crop, but the main disadvantage in using it is that cer-

Fig. 71.—Two watermelon fields: upper, not supplied with enough organic matter and nitrogen; lower, healthier vine growth due to proper supply of plant food. (Seaboard A. L. Ry.)

tain diseases may be carried to the field, especially if hay from a melon field has been fed to the animals. Humus is very essential (Fig. 71). Many growers select new land which has just been cleared and which contains a good supply of humus. If

barnyard manure is used, it may be applied in the furrows, or a forkfull may be used on either side of each hill. The rate of application varies from five to ten tons per acre, depending on the method of applying it.

Green manure is safer, better, and cheaper to use. Grow a sod in the rotation or grow a dense winter cover crop, and plow this green manure under several weeks before the melon crop is to be planted. Harrow or disk the soil once a week to settle it, to warm it, and to rot the organic matter.

A complete commercial fertilizer analyzing about 5-8-5 (N-P-K) should be used if no manure is used. The rate of applying the fertilizer should depend upon the fertility of the soil. It is usually applied at the rate of 300 to 1,000 pounds per acre. Some growers apply part of the fertilizer before planting and the balance of it just as the vines begin to grow. Some growers apply about 100 pounds per acre of nitrate of soda or sulfate of ammonia as a side dressing just before cultivation ceases.

How to Apply the Fertilizer.—The barnyard manure or the commercial fertilizers should be applied several weeks before planting and should not be placed directly under the seed. The barnyard manure can be placed just beside each hill. In applying the side dressing, care must be taken not to touch the vines with the nitrate of soda or sulfate of ammonia because of the damage which will be done to the plants.

Organic Matter	Securing Organic Matter
Absorbs moisture	Grow green manure crops
Retards evaporation	Plow under cover crops
Adds plant food	Plan rotation of crops
Unlocks plant food	Turn under weed growth
Warms and airs soil	Break up sod land
Checks erosion	Disk in crop residues
Improves tilth	Incorporate barnyard manure
Favors bacteria	Use organic fertilizers

Home-mixing Fertilizers.—Where a large quantity of commercial fertilizer is to be used, it may save money by mixing the different fertilizer materials at home. The labor and available space for the work will have to be considered. By mixing the fertilizer at home it is possible to get any desired formula such

as will suit the rotation and the soil. Only the most desirable plant-food materials will be used. The two or three materials may be applied to the hills separately and worked into the soil with a harrow.

Job 6. Preparing the Soil for Planting

Conditions Usually Found.—Many growers wait rather late to prepare the soil and then fail to prepare it in the proper manner.

Aims.—The value of a well-prepared seed-bed should be understood by growers.

Problems for Study and Discussion

1. At what time of the year is the soil plowed for melons in your community?
2. How deep would you plow the soil?
3. What method of preparation is practiced?
4. What implements are used in preparing the soil?
5. How far apart are the rows spaced?
6. How are the rows laid off for melons?
7. What use is made of a disk harrow in preparing the soil?

Activities.—Compare bare fallow with other methods of preparing soils for melons.

Preparing the Soil.—It is very essential that a good seed-bed be prepared for the melon crop. Soil should be plowed several weeks before the planting time. Growers use a good turning plow to turn under a green manure crop several weeks before time to plant melons. An average depth of from six to eight inches should be maintained in turning the soil. It is a good practice to harrow the soil with a spike-tooth harrow or disk harrows once a week to control moisture, destroy cut-worms, kill weed seeds, warm the soil, rot organic matter, and prepare a good seed-bed.

Marking Rows.—Most growers lay off drill rows ten or twelve feet apart each way for watermelons, and about half this distance for the other melon crops—cantaloupes, cucumbers, squash, and pumpkins. It is also a common practice to plant cucumbers, squash, and cantaloupes in five-feet drill rows (Fig. 72).

Job 7. Planting the Vine Crops

Conditions Usually Found.—Several seed are planted in each hill and covered from one to two inches deep. In some cases, the seed are planted in furrows to allow frost protection to be given to the young plants.

Aims.—Growers should understand how to plant, the value of careful planting, and the advantages of an early crop.

Problems for Study and Discussion

1. What have been the earliest planting dates for each of these crops for your community?
2. How many seed are planted in each hill for the different types of vine crops?
3. How deep would you cover melon seed?
4. How are the young plants protected from frost in many localities?
5. How many pounds of seed are needed to plant an acre?
6. What advantage do you see in planting twice, once about ten days after the first planting?
7. What is meant by a re-plant?
8. Describe the transplanting method for cantaloupes.

Activities.—Practice different methods of planting and compare results.

Fig. 72.—The bush type of squash is readily grown on ridges if desired.

Planting.—Seed are usually planted by hand, except where the crop is planted with the drill. If planted in hills, not less than ten or twelve seeds should be scattered in each place. Plant when there is enough moisture in the soil to germinate. The seed may be dropped and covered by using the foot or hoe. Cover the seed about one to two inches.

Many farmers plant twice in the same hill, about ten days apart. Then if the first planting is killed by the frost, the second planting will be about ready to come up. If the first planting does not get killed, the second planting is destroyed during the first cultivation.

Transplanting Cantaloupes and Cucumbers.—In a few regions where markets and soils are very favorable to these enterprises, a few growers often start a few hundred plants in hotbeds or cold-frames very early in the season. The seed is

planted in paper cups, in inverted sods, or in veneer boxes to aid in transplanting without disturbing the roots. The plants are set in the fields after the late spring frosts are over. The crops are thus advanced several weeks (Fig. 73).

Job 8. Cultivating the Vine Crops

Conditions Usually Found.—Many growers wait too long to cultivate melons or cultivate them when the vines are too large.

FIG. 73.—The trough method of growing and protecting young cucumber plants after they are transplanted to the field in cool weather enables growers to reach early markets. Piles of troughs and overhead irrigation pipes are shown. Pickers are at work. (Seaboard A. L. Ry.)

Aims.—The value of good cultivation, and the danger of cultivating them too late should be understood.

Problems for Study and Discussion

1. When should you begin the cultivation of melons?
2. What implements do you need?
3. What thinning is practiced?
4. Of what advantage is pruning the vines?
5. How is the fruit thinned?
6. What is the difference in appearance between a male and a female flower of the melon family?

Activities.—Test and compare the costs and results of different methods of cultivation and hoeing.

Cultivating Melons.—The first cultivation for melons is usually given just as soon as the young plants get above the

ground. Often the cultivation is done with a two-horse cultivator. Sometimes it is necessary to hoe out weeds in wet seasons. Cultivate only when the vines are dry and discontinue all cultivation when the vines begin to fruit. Cultivation at that time causes the fruit to fall off.

Thinning and Pruning.—Watermelons are usually thinned to one plant to the hill. Often two plants are left in each hill for cucumbers, cantaloupes, and squash where the hill system is used. In some cases the three latter crops are planted in drill rows and only one plant left in any one place.

In many cases, growers have found it advisable to prune the ends of watermelon vines so that all available plant food would go into the production of the melons. The fruit for watermelons is thinned to one or two melons to the vine. This method gives less melons in number but more that are of the size demanded by the market.

Job 9. Controlling Insects and Diseases

Conditions Usually Found.—Plant lice and the striped cucumber beetles usually do considerable damage to the melon crop. Diseases common in most communities are anthracnose, stem-end rot, downy mildew, wilt, and nematodes.

Aims.—Students should know how to identify these enemies, and learn how each of them may be controlled.

Problems for Study and Discussion

1. At what time are the plants usually attacked by plant lice?
2. What methods of control are used against plant lice?
3. At what stage is the striped cucumber beetle injurious to the melon crop?
4. Identify plant lice and the striped cucumber beetle. Why are they not controlled by the same method?
5. Find out if downy mildew injures melons in your community. How may it be detected?
6. Describe a melon plant that is attacked by the wilt.
7. How is the wilt controlled?
8. How can a wilt-resistant variety of watermelon be secured?
9. Describe the damage caused by stem-end rot.
10. How is the stem-end rot controlled?
11. How are melon plants injured by the root-knot nematodes?
12. To what extent do cut-worms give trouble in your community? How do you control them?

Activities.—The dusting and spraying equipment should be tested and put in shape for use. Compare dusting and spraying for insects (Fig. 74).

Plant lice usually appear on the young plants just after they come up. The damage is done by the lice sucking the plant

juice. They may be controlled by dusting or by spraying with nicotine sulfate.

The striped cucumber beetle is small and has a black head with a yellow throat. The beetles are able to multiply rapidly and may do damage to the vines as well as to the melons. This beetle is an eating insect and may be controlled by spraying with a poisonous spray. Arsenate of lead is usually mixed with Bordeaux mixture for controlling the cucumber beetle and certain diseases at the same time.

The cutworm attacks many kinds of plants. The young plants are cut off just above the ground. The cutworm may

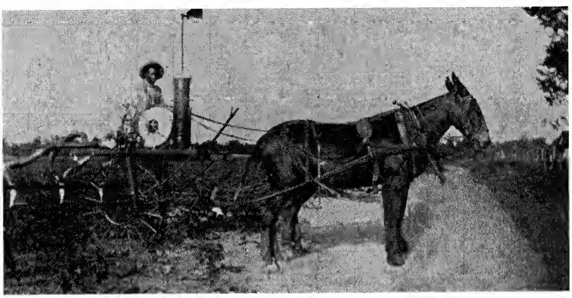


FIG. 74.—Dusting machine used for control of insects and diseases. (F. T. Mitchell, Wilson, Ark.)

be controlled by the use of poisoned bran bait. Several harrowings a few days apart before planting should develop and destroy the cut worms.

Anthracnose and downy mildew cause black spots to appear on the fruit and the vines. Both of these diseases may be held in check by the proper spraying of the young vines with Bordeaux mixture. Treating seed with semesan before planting aids in controlling seed-borne diseases.

Wilt of melons is caused by a fungus. The spores are able to live over in the soil and attack the plants the next year. Spraying seems to be of very little value in controlling the wilt. It may be recognized by noticing a vine apparently in good condition which dies a few days later. The only safe control is to practice at least a five-year rotation for melons. Wilt-resistant strains of seed should be used if possible.

The stem-end rot is caused by a fungus which enters the mature watermelons through the stems after they have been harvested. Melons so infected may all decay in transit. The disease may be prevented by the application of a paste made from equal parts of starch and copper sulfate. First dissolve the copper sulfate in water. Make a paste with water and the starch. The two solutions are then mixed together and quickly boiled a few minutes until the paste is of the right thickness and is smooth enough to be applied with a paint brush. Each melon is treated by cutting the stem afresh and painting it with the paste.

Job 10. Harvesting, Grading, Packing, and Loading

Conditions Usually Found.—Watermelons are usually cut from the vines, hauled by truck or wagon to the car, and packed in the car. They are graded during the packing at the car. Cucumbers and cantaloupes are graded at the packing house.

Aims.—How to pick, grade, and pack each of the vine crops should be understood.

Problems for Study and Discussion

1. How can the grower tell when watermelons are ready for harvesting?
2. Describe how the watermelons are picked from the vines.
3. What precautions are taken to prevent injury in handling watermelons?
4. What is the best size of watermelon for the market?
5. How many watermelons are needed to load a car?
6. Describe how watermelons are packed in the car and how the car is prepared before loading the melons.
7. How are watermelons treated for stem-end-rot?
8. When are squash and cucumbers ready for the market?
9. How do growers tell when to harvest cantaloupes?
10. How are cucumbers, cantaloupes, and squash graded for market?
11. What kind of packing house is needed for cucumbers and cantaloupes?
12. What type of crates are used for shipping cucumbers? Squash? Cantaloupes?
13. How would you order a car for shipping watermelons?
14. What is the best kind of car to use in shipping melons?

Activities.—Visit a field where these crops are being graded and loaded for shipment. Participate in the work.

When to Harvest.—Watermelons are harvested just as the meat or flesh gets red. Experience is necessary in order to be able to tell the exact stage of ripeness at which to pick them. This may be told by the sound made when the melon is thumped, by the yellow tinge on the outside of the melon, and

by the normal dying of the curl or tendril at the stem end of the melon (Fig. 75).

Cantaloupes are picked after they have developed their sugar content but before they are fully ripe. They are harvested when the sugar content is developed and when the stem attachment to the melon is easily broken. A picker may have to cut open several melons until he can tell by experience. Cantaloupes will not keep after they get ripe and should be harvested every few days during the harvesting season.

Fig. 75.—When watermelons are hauled from the field to the cars they must be handled with care. The truck is lined with old quilts.

Cucumbers and squash are harvested according to size rather than ripeness. They should be harvested while the fruit is still tender.

Method of Harvesting.—Watermelons are usually cut from the vines with a knife. Men go through the field and cut the ripe melons from the vines and turn them over so that the haulers may see them. Trucks are driven down the field every eighth or tenth row and the loaders work from both sides.

Cantaloupes, cucumbers, and squash are usually picked by hand and placed in lined baskets and carried to the packing house.

Prevention of Injury.—The melon crop is very easily injured where the fruit is not handled carefully (Figs. 75 and 76). Trucks and wagons for hauling watermelons should be

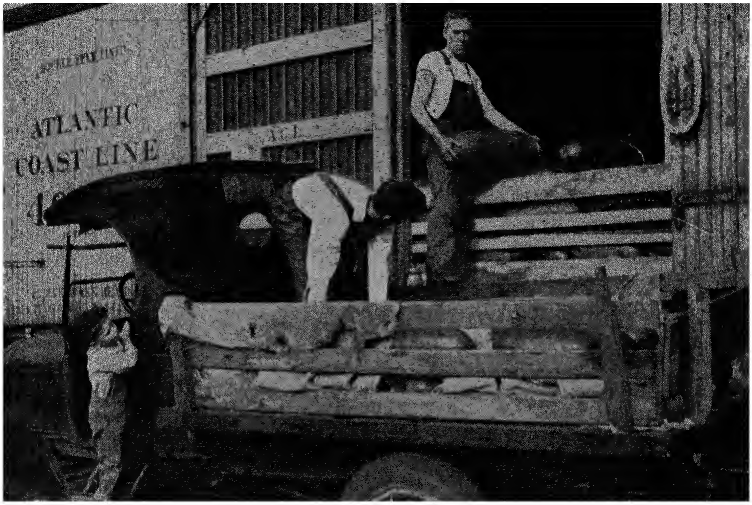


FIG. 76.—Loading car with watermelons of uniform grade.

FIG. 77.—Plan of bedding and loading watermelons in freight car. Four layers twelve melons wide are shown.

lined with some kind of soft material to prevent bruises. Do not let the melons stay in the sun after they have been picked.

Packing Watermelons.—The car for watermelons should be clean and disinfected. Several inches of bedding such as excelsior or straw should be placed in the bottom of the car (Fig. 77). Native bedding may be used, as pine needles, if the community or state is free from the cattle tick. The car should be lined on the sides with stiff paper, the ventilators being kept uncovered. The packer stands in the end of the car and the driver comes up to the door with the melons and hands them to the packer. The melons are placed side by side in the end of the car with the stem end towards the center. It varies according to the size of the melons, but generally it takes from fourteen to sixteen melons for the first row. The second row is placed on top but between the melons of the first row, thereby taking one melon less. The third row takes the same number as the first. Four layers usually make all that is used for the car. After the four layers are packed the ends are then treated for stem-end rot as described in Job 9. The average car will hold from six hundred to a thousand melons, depending upon the size.

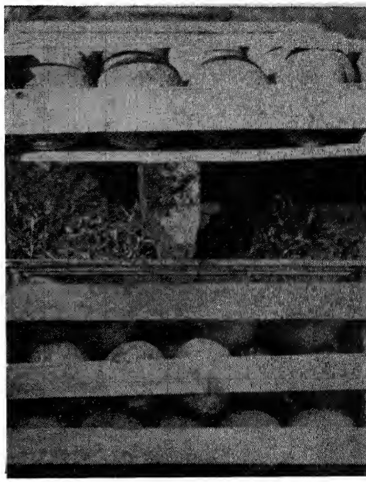


FIG. 78.—Two sizes of crates used in packing graded cantaloupes; upper, holding one layer, is much used in the early part of the season when prices are highest.

Recently, growers have planted some of the thin-rind varieties of watermelons and shipped them to market. Such varieties have to be carefully packed, melon-by-melon, in excelsior. Less melons are required for a car and prices may sometimes be as high per car as for the thick-rind varieties.

Packing Cantaloupes.—At the packing house careful grading is done. Usually there are three sizes: 4-inch, $4\frac{1}{2}$-inch, and over $4\frac{1}{2}$-inch. Crates commonly used are 12 x 12 x 24 inches.

These crates hold about 45 of the 4-inch melons and less of the larger melons. The crate should be so over-filled that it has a bulge when fastened. If possible, cantaloupes should be picked, graded, packed, and shipped the same day (Fig. 78).

Packing Cucumbers.—If the product is for fresh cutting, cucumbers are graded according to size into three grades: No. 1, No. 2, and No. 3. They are classed as small when they are under six inches, medium when six to nine inches, and large when over nine inches (Figs. 79 and 80).

Cucumbers are generally packed in bushel baskets or hampers (Fig. 81). Crates are used by some growers. The cucumbers

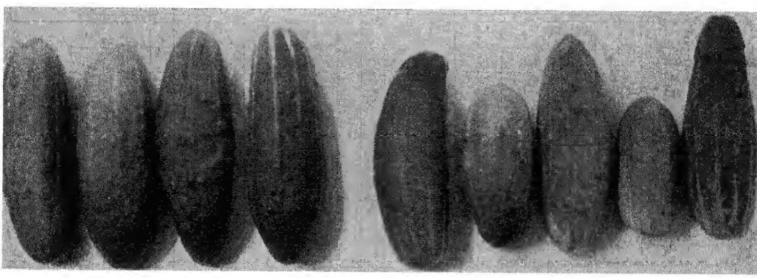


FIG. 79.—Four cucumbers on the left practically uniform in size, shape, and coloring. These are much more attractive and saleable than the five irregular and defective specimens (culls) shown on the right.

should be so packed that the fruit cannot move in the package.

Packing Squash.—This crop is graded according to size and packed in bushel hampers or in bushel baskets. In some places, each squash is wrapped in paper as it is placed in the basket or hamper. This practice is to prevent injury.

Job 11. Marketing the Melon Crop

Conditions Usually Found.—Many growers consign their melons to commission firms. Some sell f.o.b. the local station. In some places there is a well-organized marketing association.

Aims.—Growers should learn the different methods of marketing and the advantages or disadvantages of each method.

Problems for Study and Discussion

1. What methods of marketing are used in your community?
2. Where may a grower get market reports?
3. What is meant by consigning melons?
4. What are the advantages of selling melons f.o.b. the station? What are the disadvantages of this method?

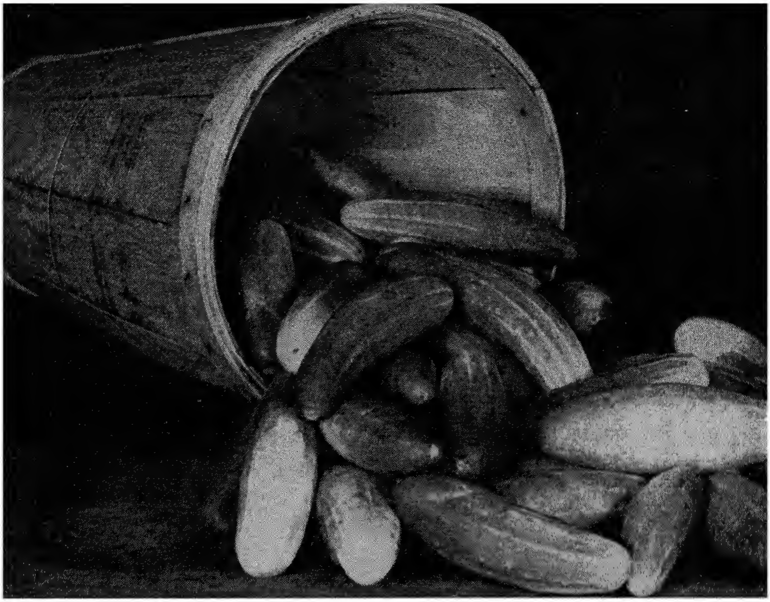


FIG. 80.—U. S. No. 1, White Spine cucumbers, showing some misshapen specimens. The style of bushel hamper used for cucumbers is shown.

FIG. 81.—Bushel size of cucumber hampers packed in a car. It is customary to load 400 hampers to each car.

5. What is auction selling?
6. Give reasons why some markets may be glutted.
7. What are the advantages of coöperative marketing?
8. What are the functions of marketing?
9. What is the freight rate on a car of melons from your station to New York City, or other central market?
10. Compare shipping by express with shipping in car lots.

Activities.—Visit commission firms to study how receipts are handled. Obtain copies of contracts for f.o.b. sales.

When Melons are Marketed.—The season for marketing watermelons usually opens in South Florida about the first of May, reaching the latitude of Georgia the first of June, and the latitude of South Carolina the latter part of June. Probably more melons are marketed during the month of July than any other month.

Cantaloupes have about the same seasons as watermelons but do not last quite so long.

Cucumbers and summer squash are generally about one month earlier than watermelons. The picking season for cucumbers lasts much longer.

Methods of Marketing.—In many localities the buyers come to the producing areas and purchase the melons as they are loaded on the car. These men may represent commission houses or they may buy the melons and run the risk of prices changing. Where melons are being graded properly, it is possible to sell them f.o.b. the local station to jobbers by wire. The advantage of selling to the buyer on the ground is that the grower gets his money when the product is delivered and is certain of the price. Such buyers, however, have to give prices low enough so they can play safe in selling the product at a profit.

Possibly more melons are consigned by the grower to commission men than are sold in any other one way. If the grower is dealing with an honest firm and grades and packs his melons right, he will usually secure fair returns unless the markets become overstocked. The chief trouble with this way of marketing is that too many growers may ship to the same city and glut the market.

In many localities the growers have organized coöperative marketing associations. These associations, when properly managed, usually give each member a profit over the other methods of marketing.

Job 12. Keeping Records

Conditions Usually Found.—(1) Too few farmers keep any records to show the cost of growing and marketing crops. (2) Successful farmers find record-keeping advantageous.

Aims.—(1) The keeping of simple accurate records should be well understood. (2) Students should be able to summarize records.

Problems for Study and Discussion

1. Ask farmers why they do or do not keep farm records.
2. Use an inexpensive blank book and rule a page suitable for keeping a record of labor, of hired help, of horses, and of yourself. Leave room for entering all the labor of this enterprise.
3. Rule another page for recording the miscellaneous expense items of the enterprise, such as land rent, insurance, use of implements, seed, barnyard manure, fertilizer, crates, etc.
4. Rule another page for keeping a record of items of income, such as sales of crops, credits for products used on the farm.
5. With a set of such blanks visit one of your best farmers and get him to give data or estimates for his last crop.
6. What prices should be charged for rent? For insurance? For use of implements? For barnyard manure?
7. What prices have been paid for labor, for seed, for fertilizers?
8. What prices have been received for products?
9. What allowances should be made for products used on the farm?
10. From data obtained, calculate the profit from an acre or from the whole enterprise.
11. Tell how to find the labor income of the owner and calculate it in one case at least.

Activities.—(1) Rule off all sheets or pages suggested in this job and fill in items for one field. (2) Calculate all cost items for the field. (3) Calculate total income and net profit at market prices. (4) Write to your State College of Agriculture for record books for all farm enterprises.

Keeping Records vs. Guessing.—Farmers often pursue a number of enterprises in the same year. It is impossible for them to remember without records all details regarding the time spent in each enterprise, the distribution of the labor hired for all the enterprises, the right amount of horse labor, the exact amounts of seed, fertilizer, and other miscellaneous items. They are unable to remember, without records, how much to credit the enterprise for sales and products used on the farm. When the enterprise is completed or when the year cycle is reached there is no certain way, without records, of knowing the profits or losses, there is no way of calculating the labor income, and the grower is uncertain whether he has any net income or not.

He can easily estimate or remember the items of rent, insurance, and taxes.

Cost of keeping accounts is extremely small if simple forms are devised for each enterprise (Fig. 82). Enterprise record books may be obtained for five or ten cents or pages may be ruled in a blank book for the purpose. Student project record books are suitable for each crop.

The value of records is easily estimated. They lead the farmer to better knowledge of his business. They show his

FIG. 82.—Students should make study desks and cases for holding books and bulletins at home. Keeping simple records is easy when proper plans are made. Future farmers should become business farmers. (U. S. Bu. Agr. Econ.)

labor income, they aid in making his income-tax report, they settle uncertainties regarding hired help, use of implements, miscellaneous expenses, and sales. They show the grower which enterprises are profitable and which are not. They aid in solving national economic problems regarding costs of production.

Annual Inventory.—In each farm enterprise it is important that the equipment available at the beginning of the enterprise should be recorded in a list called an inventory. At the end of the year the inventory should be gone over again in making

a new list. The comparison of the two will show how much the items in the list and their valuations have increased or decreased during the year. If the total has increased, the enterprise must be credited; if it has decreased, the enterprise must be charged with the difference.

In making up each list, include the kind of property, number or quantity, the price of each unit, and the value. Use actual market values at the farm as nearly as possible.

Inventory

Items	Beginning of Year			Close of Year		
	Quantity	Price	Value	Quantity	Price	Value
	Total		$	Total		$
Net increase or decrease for year			$	....		$

Labor Record.—An account should be ruled for keeping records of each of the labor jobs of the enterprise. This form should show the labor which is hired, the labor of the grower, and horse labor. In ruling such a form, allow a column down the left-hand side of the page for the date. The next column should be a little wider; write in it the kinds of operations, as plowing, harrowing, cultivating. The other columns should be headed as shown and should be divided into three parts, "Hired Labor," "Self Labor," "Horse Labor," with "Hours" and "Cost" for each. If such a labor page is ruled for each of the farm enterprises the labor of each day can be distributed in a few moments.

The example on p. 178 shows that on May 15th the grower hired a man at twenty cents per hour to operate one of his cultivators and operated the other himself at the same charge, and

that four horses were at work at the rate of fifteen cents per hour each.

Labor Record

Date	Item	Self Labor		Horse Labor		Hired Labor	
		Hrs.	Cost	Hrs.	Cost	Hrs.	Cost
May 15th	Using two cultivators	8	$1.60	8	$1.60	32	$4.80

Tractor Record.—If a tractor is operated regularly on the farm, a record should be kept of the gas, oil, grease, and repairs. Enter also annual interest, depreciation, and taxes. Its use in each enterprise should be charged in the labor record or in the miscellaneous expense record.

Miscellaneous Expenses.—There should be a separate page to show expenditures not included as labor, such as fertilizer, manure, seed, rent, interest, insurance, taxes, and use of implements. This may be in the following form:

Miscellaneous Expense Record

Date	Item, Quantity, Price	Amount
Oct. 1st	Land rent for 20 acres, @ $5.00	$100.00
June 1st	1 ton Nitrate of Soda	60.00

Receipts.—There should be a page showing actual receipts and uses of the crop. Rule a page in three columns as shown. Enter in this record all sales and parts of crop used on the farm.

Receipts

Date	Item Sold	Value
June 15	Car of Melons	$250.00

Summary Statement.—From the preceding records it is easy to make a summary at the completion of the year (or enterprise cycle) for each enterprise. For this purpose rule a page as shown.

Summary Statement

Expenses	Amt.	Receipts	Amt.
Inventory, first of year Miscellaneous expenses Hired labor Horse labor (1) Self labor		Inventory, last of year Receipts—cash Used on farm	
(2) Total cost (3) Total out-go (2) minus (1)		(4) Total income (5) Net income (4) minus (2)	
		(6) Labor income (4) minus (3)	

Such a summary gives the grower a clear insight into the results of the enterprise, and gives the amounts of the cost items, change in inventory, amounts spent, total income, net income, and his labor income. A study of these items makes them a guide to future undertakings.

Labor Income.—After calculating all expense items except the labor of the grower we may deduct the sum from the total receipts record. This difference may be called the real profits or the "labor income" of the grower.

Melon Calculations.—1. A grower desires to borrow $350 for growing a crop of watermelons. He is offered the money by the bank at 8% per annum for six months. A friend offers him the money for one-tenth of the net profit on the five acres. The average yield he considers is 400 thirty-pound marketable melons to the acre and the net profit per melon is 5 cents. Where should he borrow the money?

2. A young man uses per acre 400 pounds of a 5-8-5 fertilizer at $42.50 a ton and 100 pounds of nitrate of soda at $40 a ton. What will be the cost of fertilizer for 7 acres?

3. In packing a car of watermelons the packer uses 16 melons for the first row and 15 for the second row placed above the first. If the car has 11 rows in each layer packed four layers deep, how many melons will be needed to fill the car?

4. How many cars are needed to ship a 7-acre crop yielding 400 per acre, if loaded as in problem 5?

5. A student produced 300 crates of cucumbers per acre. After removing 16% that amount of culls, he found he had 10% of No. 3; 14% of No. 2; and the remainder was No. 1. How many crates did he have of each grade on 5 acres?

6. What would be the value of the cucumbers in problem 5 if the prices are as follows: No. 1, $2.00; No. 2, $1.65; No. 3, $1.25; and culls, 50 cents?

7. On ten acres of watermelons a student produced 14,000 pounds. It took 400 man-hours, 208 horse-hours, and 208 equipment-hours to produce them. What was the number of man-hours per 100-pound unit? Horse-hours per unit? Equipment-hours per unit?

8. It cost the student $285.90 to produce the ten acres in problem 7. The total receipts were $893.30. Find the net income per unit and the net income per man-hour.

9. What interest did the student make on his investment in problems 7 and 8?

ENTERPRISES WITH TOMATOES, EGGPLANTS, AND PEPPERS

Collaborator: J. G. Woodroof, Ph.D., Formerly Professor of Horticulture, Georgia Experiment Station.

The tomato, the most important of this group of vegetables, is believed to have originated in South America. It is reported to have been grown for use as a food in Virginia as early as 1781 and to have been offered on the New Orleans market in 1812. The pepper is supposed to be a native of Brazil, and its use was restricted to that of a seasoning until the development of the sweet, or manzo types. The eggplant may have originated in the East Indies. These are warm-region crops, with eggplants exhibiting the highest temperature requirements. The growth of eggplant may be checked seriously if subjected to cool weather. For this reason it is recommended that eggplant not be set in the field when mean temperatures are below 65° to 70° F.

Analysis into Jobs.—Since tomatoes, eggplants, and peppers all belong to the same family and have practically the same cultural methods, they are grouped together for study. The following is a list of the farming units or jobs in an enterprise with one of these crops.

Job 1. Determining Possibilities with Tomatoes, Eggplants, and Peppers

Conditions Usually Found.—(1) These crops are grown commercially in many sections of the United States. (2) All of these crops are grown out of season in states bordering the Gulf, or in similar climates, but are more common in colder climates. (3) Experienced farmers usually produce satisfactory yields.

Aims.—Students should understand the requirements of each of these crops and study all factors effecting success with them, including probable returns to be expected in each case.

Problems for Study and Discussion

1. To what extent are tomatoes, eggplants, and peppers grown commercially in your community?

2. How many crates per acre of each of these crops are produced locally?
3. What are the average prices received per crate for each of these crops during the past five years?
4. What is the average cost per acre in growing each of these crops?
5. What diseases and insects injure these crops?
6. How much are farmers increasing the acreage devoted to these crops?
7. What difficulties have growers experienced in marketing these crops?

FIG. 83.—Eggplants in the Gulf region may be ready to yield before the northern crop is planted. Photographed in April.

Where These Crops are Grown.—The leading states in the production of fresh tomatoes for shipment, according to recent reports, are in about the following order: California, Texas, Florida, New Jersey, New York, Maryland, and Michigan. Tomatoes are grown to some extent in every state in the United States. Part of the crop in each state is grown for canning. Commercial canneries seldom buy early tomatoes.

Eggplant is grown commercially in just a few states. Florida, New Jersey, Louisiana, and Texas are the leading shipping states in the order mentioned (Fig. 83).

The leading states in producing peppers for commercial purposes are Florida, California, New Jersey, Georgia, Louisiana, North Carolina, Texas, and Mississippi.

The average yields of each of these crops vary from one section to another and for different seasons. Tomatoes should yield from 75 to 250 bushels per acre, depending upon the season and the kind of soil. Peppers usually produce from 175 to 300 crates per acre. The usual yields of eggplant per acre are from 200 to 400 crates.

The prices usually received per crate for each of these crops vary during the season and for different years. Florida usually receives the highest, as its crops are marketed in the winter and early spring months. These crops should not bring, on an average, less than one dollar per crate, and it is not unusual for a man to get $4.50 to $5.00 per crate for each crop at the first of the season. As a general rule, tomatoes will probably bring more per unit than eggplants and peppers. The earliest crops are produced farthest south and these bring the best prices.

The costs for growing an acre of tomatoes, peppers, or eggplants vary, depending upon the cost of labor, the rent of land, the kind and amount of fertilizer used, and other factors. In most cases the cost should not average more than $150 per acre. The costs usually vary between $100 and $200 per acre.

Job 2. Choosing the Crop and the Variety

Conditions Usually Found.—(1) Farmers as a rule grow only one variety. (2) Certain varieties are grown because of their ability to stand shipment, or because of earliness.

Aims.—Students should decide which of these crops to grow and then select a standard variety.

Problems for Study and Discussion

1. Which of these crops do best in your community?
2. Make a list of the different varieties grown in your community for each of these crops.
3. Which varieties would you select?
4. What are the advantages to a community of specializing in one variety?
5. Discuss the value of earliness.
6. Why should the variety be a good shipper?

Variety to Grow.—Earliness is a very important factor in growing these crops for market. Market preferences should also be taken into consideration. Probably the leading varieties of tomatoes, with average days required to mature, are: Livingston

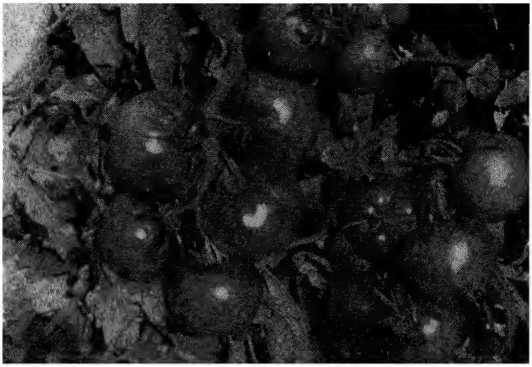


FIG. 84.—Globe tomatoes showing style of fruiting.

Globe (Fig. 84), 71 days; Early Detroit; Earliana, 60 days; Stone, 67 days; Bonny Best; Tennessee Beauty, 69 days; and Marglobe, 71 days. The last two are wilt-resistant.

FIG. 85.—Smooth specimens of green peppers attract buyers. (Seaboard A. L. Ry.)

The Georgia Station showed the New Stone to be the best-yielding variety grown, with a 6-year average of 14,846 pounds per acre, or 9,374 pounds marketable. Earliana was second with 13,361 pounds, or 6,518 pounds marketable.

The leading varieties of peppers are Ruby King, World Beater, and Bull Nose. (Fig. 85.) The Perfection variety of the Pimiento is used considerably for canning.

There are three distinct type colors of eggplants: black, purple, and greenish-white. The black-fruited varieties are the most popular, and the Black Beauty (Fig. 86), New York Purple, and the Florida High Bush are probably the leading varieties. In most sections, the Black Beauty is decidedly the most popular for commercial planting.

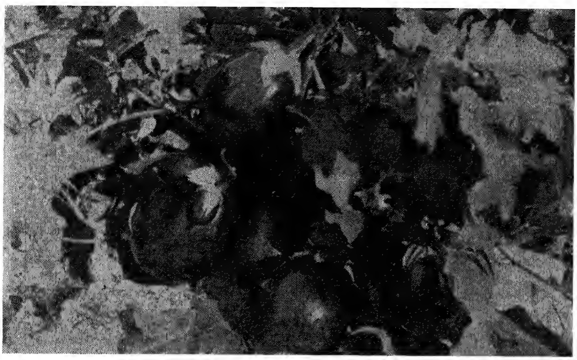


FIG. 86.—Black Beauty variety of eggplant. Some are ready to harvest.

Job 3. Selecting the Soil and the Field

Conditions Usually Found.—(1) Farmers select the field as near the shipping station as possible. (2) Disease-free soils are selected.

Aims.—Students should understand the importance of selecting soil which is free from disease and a field which is near the shipping station.

Problems for Study and Discussion

1. What soils in your community are used for growing these crops?
2. What rotations are practiced by farmers?
3. Discuss the importance of selecting disease-free soil.
4. Why should the field be located near the shipping station?
5. What effect has the slope of the field on earliness?
6. Of what importance is soil drainage?
7. What are farmers' preferences as to soil fertility for these crops?
8. Suggest suitable crops for these to follow.

Soil Preference.—These crops may be grown on a wide variety of soils, and there is a difference of opinion as to the best soil. For the early spring crop, however, most farmers prefer

a rich, sandy loam soil. Muck and clay loam soils are also used in many sections.

Since wilt and several other fungous diseases may live in the soil, it is very important that soil be selected which is free from these diseases. The safe plan to follow is to provide for a rotation so that these crops are not grown on the same soil often. Leguminous crops and other green manure crops should precede the planting of these crops.

Location of Field.—The fruits of these crops are easily bruised, and therefore it is important to locate the field as near as possible to the shipping station and near the packing shed.

Fields sloping to the south or to the southeast will probably warm up earlier in the spring and make possible the planting of the crop a week or two earlier. Fields surrounded by thick timber are valuable because of the protection they give from light frosts and from cold spring winds.

Job 4. Obtaining Seed; Testing and Treating

Conditions Usually Found.—(1) Farmers usually purchase the seed for planting these crops. (2) Few farmers ever test seed or treat it before planting.

Aims.—Students should understand methods and reasons for obtaining good seed. They should also learn the value of testing and of treating seed before planting.

Problems for Study and Discussion

1. What methods of securing seed are practiced by the farmers in your community?
2. Compare these methods of obtaining seed.
3. What improvements may be made by field selection of seed?
4. How may a wilt-resistant strain be developed?
5. How long will these seeds keep their vitality?
6. How much seed of each crop is needed to furnish enough plants for an acre?
7. How may seeds be treated for fungous diseases?
8. Describe a good method of testing seed for vitality.

Activities.—Rogue a field for purity and resistance to disease. Select seed, and test and treat it.

Securing Good Seed.—For these crops seeds may be saved by the farmer and stored until the next season in a dry place. In practice, however, too few farmers save seeds at home. Care should be taken when buying seeds to patronize reliable seedsmen.

Seeds stored in a warm, moist climate may soon lose their

vitality. For this reason, it is better to plant only seeds which were grown the previous season.

Amount of Seed Needed.—It is always best to purchase more seeds than are actually needed so as to allow for poor germination or injury which may happen to the young plants. Usually from four to five ounces should furnish enough plants to set an acre. If these seeds are to be planted in the drill in permanent rows, then two or three times this amount will be needed. The practice of planting in drills in permanent rows is followed by some farmers in the southern regions, especially for eggplants.

Fig. 87.—Plant of bell peppers showing good development of fruit. A good plant from which to save seeds. (Seaboard A. L. Ry.)

Field Selection of Seed.—In the field select for seed those specimens which are early, best grade for market, free from disease, and are borne on heavy-yielding plants (Fig. 87). The crops may be greatly improved from year to year by such careful selection of the best. Seedsmen are not always able to give as close attention to all the points as the best growers may give.

If a field is badly attacked by wilt disease, a few plants may withstand the disease. In such a case, the grower may choose seed from resistant plants, and, by continuing this plan, may establish a wilt-resistant strain.

Testing Seed for Vitality.—After seed has been obtained, a farmer should test each lot for vitality so that he will know how thick to plant. Probably the best way to test seed is by the rag-doll method, as outlined in the Melon Enterprises.

Treating Seed.—The fungous spores of several diseases live over in the seed. These spores may be killed by using one tablet of bichloride of mercury (corrosive sublimate) in a pint of water. Soak the seed first for several hours in water and then place

them in the bichloride of mercury for three to four minutes. After the seed is washed carefully in running water for several minutes, it is then planted. A material more recently used by station trials is semesan. Use one-fourth of one per cent water solution, soaking the seeds for thirty minutes. This not only kills the spores but aids in germination.

Job 5. Locating, Preparing, and Managing Plant-beds

Conditions Usually Found.—Plant-beds are usually protected from wind, exposed to the sun, and are near a good water supply.

Aims.—Students should understand the importance of locating plant-beds properly, and should understand good management.

Problems for Study and Discussion

1. What kinds of plant-beds do the farmers in your community use?
2. What sources of heat do they use? Which method of supplying heat is considered best?
3. Describe the construction of a hotbed.
4. What kind of soil is used in the hotbed?
5. Suggest the best time for sowing seed.
6. What use do farmers have for cold-frames?
7. Give practices of farmers of your community regarding transplanting the plants before setting them to the field. Give frequency, sizes of plants, and places.
8. What should be the temperature of hotbeds at planting time?
9. How would you water a hotbed?
10. How much ventilation would you give a hotbed? Give rules as to time of day, and temperatures for opening and closing.

Activities.—Make a hotbed (Fig. 88) and grow plants for field use.

Locating the Plant-beds.—It is well to locate the plant-bed where protection from cold winds is possible and where there is a convenient water supply. On the south side of a building or other windbreak is a good location.

Kinds of Plant-beds.—Most farmers who grow tomatoes, eggplants, or peppers raise their own plants in specially constructed hotbeds. Such beds have some form of heat from the bottom, and are covered with either glass or white cloth. The beds are dug six feet wide and as long as needed, in multiples of three feet. The area is dug out to the depth of twelve to fifteen inches. The frames for the beds are usually constructed two feet high at the north side and one foot high at the south side. The standard sashes are usually bought in one size, 6 x 3 feet. The beds may also be covered with a good grade of white cloth which has been treated with linseed oil, with alum and

sugar, or with lead, to make the cloth more transparent. The cloth is sometimes treated with resin and old cylinder oil for the same purpose.

Kinds of Heat for Hotbeds.—The common method of giving heat for hotbeds is by the use of fermenting horse manure. About six inches of packed manure is used in the bottom of the hotbed, and is wet with water. Then about six inches of prepared soil is placed on the manure.

The beds may also be heated by hot water pipes in a building where a boiler is used.

Sometimes beds are heated with tile smoke-pipes placed under the beds at intervals and having a smoke-stack at the end opposite the fire. It is hard to regulate the heat by this plan unless a worker looks after the beds both day and night. If enough plants are being grown to pay for this labor, the heat from the stove pipes should prove satisfactory.

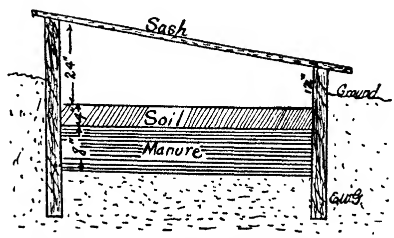


FIG. 88.—Cross section of a hotbed, showing manure, soil, air space, and glass cover.

Soil for Hotbeds.—It is important that the soil for hotbeds be free from disease spores. Good soil for this purpose may be prepared by mixing equal parts of a rich loam soil, leaf mold secured from the woods, and cow manure. Four inches of this soil is used.

Sowing Seeds.—After a hotbed has been prepared and the temperature comes down to 80 or 90 degrees F., the bed is ready for planting. The seeds are usually sown in drills about four to six inches apart, and are covered about one-half inch deep with loose soil. A moist burlap sheet placed directly on the soil will prevent baking and will aid in holding moisture. This must be removed when sprouting begins.

Management of a Hotbed.—After a hotbed is planted, care must be taken to keep the soil moist so that the seeds can germinate. It is best to water the bed with a sprinkler before and after the plants are up. The sash should be raised a little every day, if possible, so that fresh air can be admitted and the bed kept from getting too warm. A steady temperature of 70 de-

grees should give the plants enough heat for good growing conditions. After the plants are growing the sash may be removed entirely during warm days. Do not chill or stunt the plants.

Use of Cold-frames.—Some farmers advise the use of cold-frames to harden the plants before setting them to the field. A cold-frame is like a hotbed except that no bottom heat is given. When hotbed manure has spent its heat the place is then a cold-frame. Plants from the hotbed are set in two-inch checks in a cold-frame and become stocky within seven to ten days. Plants may be hardened to some extent in the hotbed by gradually exposing them to cool air. Transplanting to cold-frames not only hardens the plants but makes them develop better root systems. Experimental trials show that too much hardening becomes a runting or dwarfing process and may prove to be a disadvantage.

Hardening Under Shade.—In order to get tomatoes on the market early, some farmers practice covering an acre or two of ground with cloth, similar to a field prepared for growing "shade" tobacco. The plants are set out in one-foot checks. After all danger of frost is over, these plants are watered well and dug up with a shovel of dirt for each plant and set in the field. This method is called "spotting." The plants are about ready to bloom when they are transplanted to the field.

Job 6. Providing Manures and Fertilizers

Conditions Usually Found.—In addition to barnyard manure most farmers use commercial fertilizers. Green manure crops are often plowed under. Coöperative buying of fertilizers and home mixing is becoming more popular in many sections.

Aims.—Students should understand how to provide organic manure, and what special fertilizers are best for these crops. They should understand the advantages of coöperative buying of fertilizers and of home mixing.

Problems for Study and Discussion

1. To what extent is manure from livestock available in your region?
2. Plan a rotation which will provide green manure.
3. What kinds of fertilizers are used by farmers in your community for each of these crops?
4. At what rate is the fertilizer applied for each crop?
5. Make a list of the advantages of buying fertilizers coöperatively.
6. To what extent do farmers of your community use top dressing for these crops?

7. Why should available forms of fertilizers be used for growing these crops?
8. How many farmers in your community practice home mixing of fertilizers?
9. What reasons do growers give for or against this practice?

Activities.—Run a test to compare green manure with commercial fertilizers for tomatoes.

Barnyard Manure.—One of the best fertilizers for tomatoes, eggplants, and peppers is barnyard manure. It may be applied at the rate of ten to fifteen tons per acre for best results. In many cases only five to six tons are applied, and then some commercial fertilizer is used. Such manure supplies organic matter to the soil, and nitrogen and other plant foods to the plants.

Green Manure.—If a leguminous crop can be grown in the rotation just ahead of the truck crop, it makes a good green manure. This is the least expensive method of providing plenty of organic matter and nitrogen for the truck crop.

Commercial fertilizers analyzing 4 or 5 per cent nitrogen, 8 or 10 per cent phosphoric acid, and 5 to 6 per cent potash should be suitable for most of these crops in the southern states. Commercial fertilizers are applied at the rate of 800 to 1,000 pounds per acre. In addition to this, many farmers apply about 100 pounds of nitrate of soda or sulfate of ammonia just as the plants commence to bloom.

Home-mixing Fertilizers.—Where farmers need different fertilizer mixtures in growing truck, it is often desirable for the different materials to be purchased and mixed at home. In doing this the farmer knows what materials make up the mixture. The grower can more easily supplement the other manures by buying the materials separately.

Job 7. Preparing the Field for Plants

Conditions Usually Found.—Farmers usually prepare the soil well before setting plants in the field.

Aims.—Students should understand economical methods of soil preparation. They should know the benefits of a bare-fallow period before setting plants.

Problems for Study and Discussion

1. Which is practiced in your community, fall or spring plowing? Why?
2. Discuss the advantages of deep and of shallow plowing.
3. What implements do farmers use in preparing the soil?

4. How far apart are the rows placed for tomatoes, for eggplant, and for peppers?
5. How does harrowing or disking plowed ground in the spring help to warm the soil?
6. Enumerate the benefits of a bare fallow of six weeks before setting plants.

Activities.—Make trials to contrast two methods of preparing soils for the plants.

Preparing the Soil.—The soil should be well prepared before the plants are set; it is usually turned six to eight inches deep with a turning plow. A good practice is to disk the soil at least once after it has been turned, and follow this with several harrowings a week apart. This plan destroys weeds, grass, and cutworms and other insects. It also warms the soil by letting in air and letting free water settle to lower levels. It settles the lower soil and crumbles the surface soil.

Marking rows may be done with a three-row or a four-row marker having shovels or disks which open furrows for the plants. The distances between rows in commercial fields are usually three and a half to four feet.

Job 8. Setting the Plants

Conditions Usually Found.—Experienced growers seldom fail to get plants to live. Others often lose plants by using careless methods.

Aims.—Students should know the best methods of transplanting plants to the open field—how to take plants from the bed, how to set them, and how to fertilize them.

Problems for Study and Discussion

1. Describe good methods of taking plants from the bed.
2. What sizes of plants are used for transplanting to the field?
3. Describe some of the best methods of setting plants.
4. What is the average cost per acre for setting plants?
5. Which is better, hand or machine setting? Why?
6. Give the usual distances apart for setting each of these crops.
7. How are the plants watered when they are transplanted?
8. How many plants for each crop are needed to set an acre?

Activities.—Compare different methods of setting plants as to economy and successful growth.

Taking Plants from Bed.—The plants should be hardened a little before setting them in the field, as described in Job 5. Just before the plants are removed it is best to water the bed well so that they will pull easily. They are either pulled by hand or dug up with a trowel. Plants should be several inches

high before setting them in the field. If cool weather prevails they will grow better in the beds, and can be moved without danger later.

Setting the Plants.—Most farmers transplant by hand. It is possible to use a transplanting machine for peppers but with tender plants such as tomatoes better results are secured by hand setting. The rows are usually placed three and a half or four feet apart, and the plants are spaced about the same distances in the rows. If the plants are to be staked and closely trimmed, the distances are less than otherwise. Pepper plants are sometimes spaced closer than tomatoes and eggplants.

Small plants may be set in open furrows by using tongs or a planting stick. Soil is pressed firmly by the foot. Machine planters handle small plants more successfully than large plants.

The larger plants are best set by hand. Tall, slender plants are set slanting in the furrow with only the tops projecting. Roots later form along the stem, and dry weather will be less injurious to the plants.

Watering Plants.—This is important unless the soil is very moist at setting time. Usually about a pint of water is poured in the furrow where each plant is set. Watering may be done either before or after the setting of the plants, but dry soil should be raked over the wet soil. Plants are usually placed deeper in the field than they were in the plant-bed. A transplanting machine has a good plan of watering. Irrigation water may be supplied. (Fig. 89.)

Successful Transplanting

Prepare soil well
Plant in fresh furrow
Protect roots carefully
Choose cloudy weather
Shade plants from sun
Reduce leaf surface
Cover stems somewhat
Firm soil over roots
Water if soil is dry

FIG. 89.—Clean cultivation in a staked tomato project. Artesian well in foreground, used for irrigation.

FIG. 90.—Results of clean cultivation in a tomato project. Insert at left, cleaning out weeds from tomato rows. (A. J. Geiger.)

Job 9. Cultivating the Crop

Conditions Usually Found.—Most farmers cultivate these crops successfully but often use more hand labor than necessary.

Aims.—Students should know the value of cultivation and how to do it by the most economical methods.

Problems for Study and Discussion

1. What implements do farmers in your community use for cultivating these crops?
2. To what extent is hand cultivation practiced? Describe tools used.
3. Compare cultivation methods used by growers who have maintained a bare-fallow period before planting, with those who have not.
4. How often are these crops cultivated?
5. How long should the cultivation be continued?
6. How deep do farmers cultivate these crops?
7. Debate: Staking vs. not staking early tomatoes.
8. Discuss pruning of tomato plants.
9. What implements are best for cultivating between rows?

Activities.—Repair tillage equipment in the shop. Contrast hilling and level culture.

Cultivating the Crop.—Soon after the plants are set in the field cultivation should commence. Frequent and shallow cultivation should be given and the cultivation continued as long as fruiting will allow.

Some farmers use two-horse riding cultivators for cultivating these crops and others use one-horse implements similar to those used for cultivating corn.

If a bare-fallow period has been maintained before setting plants, the fields should be rather free from weeds. Less tillage and less hand hoeing will be necessary. Hand hoes may be used to clear the rows of weeds when necessary. (Fig. 90.)

Pruning and Staking.—In certain localities tomatoes are pruned to a single stem and tied to stakes. The stakes are made from strips one inch square and five or six feet long. They are also made of native sapling. The stakes are driven about one foot deep in the soil. (Fig. 89.) The tripod method of staking is shown in Fig. 91. Some of the advantages claimed for staking are: (1) larger fruit; (2) less injury from diseases and insects; (3) more convenient for spraying and picking fruit; and (4) more crates of marketable fruit. Staking is rather costly and many farmers who grow tomatoes on sandy soils doubt the economy of it. If not staked, the plants are not pruned at the base at all.

Job. 10. Controlling Enemies

Conditions Usually Found.—Farmers who grow these crops have to combat several different insects and diseases.

Aims.—Students should learn to identify the diseases and the insects attacking these crops and to control them.

Problems for Study and Discussion

1. Make a list of the diseases which injure these crops in your community.
2. What do local farmers do to control each disease?
3. Why is prevention better than cure for diseases?

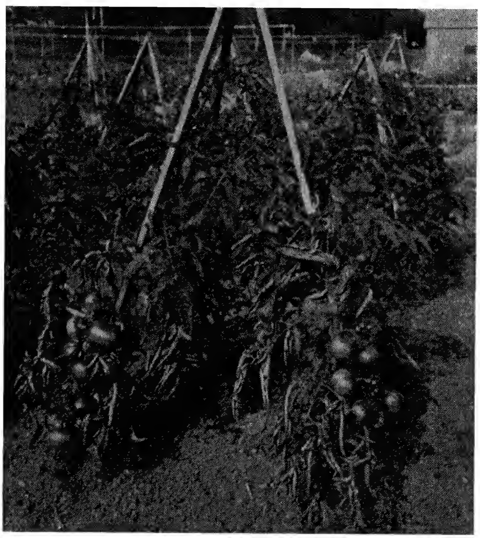


FIG. 91.—Tomatoes staked by the tripod system, with three vines to each tripod.

4. What resistant varieties are recommended to prevent outbreaks of disease?
5. What insects are injurious in your community?
6. Which is the worst insect pest of each crop? Describe damage done.
7. Discuss the control measures practiced for each insect.

Activities.—Collect and preserve specimens of insects and diseases and their effects on these crops.

Diseases.—These crops are attacked by a number of diseases which cause considerable damage. Among the diseases which attack tomatoes are fusarium wilt, bacterial wilt, leaf

spot, early blight, late blight, "nail-head" rust, and blossom-end rot.

Eggplants are attacked by a wilt similar to that of tomatoes, and by fruit rot.

Peppers are injured probably more from anthracnose than from any other disease. Mosaic and leaf spot sometimes do damage. Treating seeds and clean culture are recommended. Control of aphids helps keep down mosaic disease.

The fusarium wilt of tomatoes may be recognized by the plants wilting and the leaves curling up. The fungus causing this wilt can live from one year to the next in the soil; hence the most practical control measures are (1) the selection of soils free from the disease, and (2) the growing of wilt-resistant varieties, such as Marglobe, Marvel, Norton, and Norduke.

The bacterial wilt of tomatoes causes the plants to die more rapidly. The stem discoloration is black rather than brown. The bacteria causing this disease enter through any injury of the surface. Rotation of crops, keeping insects in check, and the prevention of injury to the plants are suggested remedies. The diseased plants should be destroyed just as soon as the disease is recognized. If the surface is kept covered with Bordeaux mixture the trouble is likely to be less severe, but Bordeaux is not a cure after the disease starts.

The leaf-spot disease on tomato plants first appears as a water-soaked place and later turns brown. Leaves so attacked dry up and fall from the plant. The best control measure is spraying the plants with Bordeaux mixture in advance.

The early and late blight of tomatoes are similar, in many respects, to the leaf spot. Both of the diseases can be held in check by Bordeaux mixture used in advance as a preventive.

Nail-head rust of tomatoes is peculiar to the South. The disease occurs as reddish-brown spots on the leaf, stem, and fruit. Spraying with Bordeaux mixture and using a rust-resistant variety (Margloble) is recommended.

Blossom-end rot attacks the fruit of tomatoes and peppers. (Fig. 92.) Treating seeds before planting is recommended. The disease is worse when the water supply is irregular. If properly used, irrigation should control this disease.

The fruit rot of eggplant attacks the plant as well as the fruit. The spots start with a grayish blotch which later develops

into a soft rot. Treating the seed with bichloride of mercury or with semesan helps to control this disease. Peppers are attacked by Phoma rot, for the control of which seed is treated.

Insects.—Tomatoes are attacked by the horn worm and by the tomato fruit worm. Eggplants are injured by flea-beetles, by Colorado potato beetles, and by several kinds of aphids. In certain cases the lace bug and the tortoise beetle also injure eggplants. Peppers are attacked by practically the same insects as eggplants.

The horn worm of tomatoes is similar to that found on tobacco. It is a large green worm, the larva of the sphinx moth.

FIG. 92.—Student studying blossom-end rot in his pepper project.

Hand picking, and spraying or dusting the plants with arsenate of lead are recommended as control measures.

The fruit worm of tomatoes (Fig. 93) is the same as the ear worm of corn and the boll worm of cotton. The worm prefers corn, and a few stalks planted along with the tomatoes will help to prevent injury to the tomatoes. Spraying with arsenate of lead will also help, and may be advisable.

The potato beetle, which attacks eggplants, may be controlled by spraying with arsenate of lead.

The lace bug sucks the juice from the eggplants and may be controlled by spraying with nicotine sulfate.

The tortoise beetle eats holes in the leaves of eggplants and may be held in check by spraying with arsenate of lead.

Aphids or plant lice suck the juices of the plants. Spraying with nicotine sulfate is very effective.

Job 11. Harvesting, Grading, and Packing

Conditions Usually Found.—Methods of harvesting vary from one section to another. Many farmers do not properly grade and pack these fruits.

Aims.—Students should know the best methods of harvesting. They should understand how best to grade and pack these crops for shipment.

Problems for Study and Discussion

1. At what stage would you harvest tomatoes? Eggplants? Peppers?
2. Describe the grades for ripe tomatoes; for green-wrap tomatoes.

Fig. 93.—Tomatoes injured by the fruit worm.

3. Into what grades are eggplants sorted?
4. What are the factors used in grading peppers?
5. What kind of package would you use for each of these crops?
6. Describe the methods of packing ripe tomatoes; green-wrap tomatoes.

Activities.—Prepare lugs and crates for this job. Practice harvesting, grading, and packing and calculate costs of each operation.

When to Harvest.—If tomatoes are to be shipped to market in ripe condition they must be harvested just before the fruit begins to turn red. (Fig. 94.) A brown ring appears around the stem cavity and the blossom-end turns a whitish-green at the proper stage for picking the fruit. A picker will soon learn to recognize the proper stage. The products known in the markets as green-wrap tomatoes are picked a little earlier than those which are to reach the market fully ripe.

The fruits of the eggplant are edible from the time they are small until they are fully grown, but are usually cut from the vines when they are of the size to suit the market.

Peppers are usually picked as they reach full size and before

Fig. 94.—Tomatoes from projects of Virginia high school students. Deciding what grading is needed. (Walter S. Newman.)

Fig. 95.—Harvesting green peppers. A truck will haul the crates to the packing shed. (A. A. Clout.)

the pods begin to turn red. (Fig. 95.) Most markets prefer green sweet peppers. Peppers for canning are allowed to ripen on the plants.

Prevention of Injury.—These crops should be handled with extreme care, because if the fruit is injured it will probably be worthless when it reaches the market. Baskets, lugs, or crates used by the pickers are often lined with some kind of soft material in order to prevent injury.

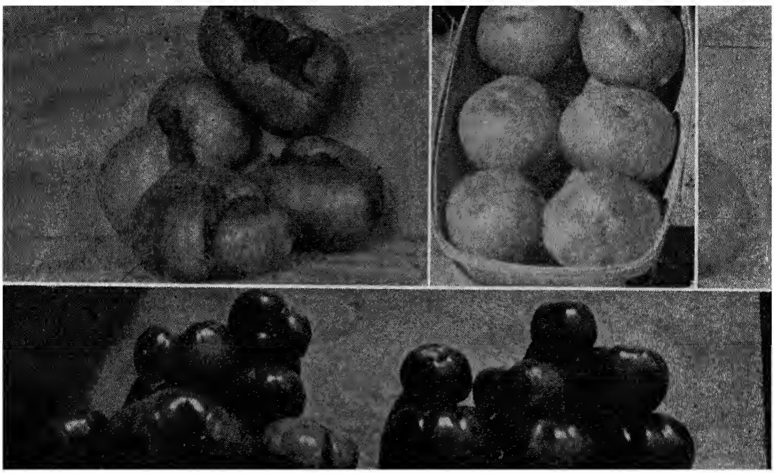


FIG. 96.—Cull tomatoes on left, misshapen, curled, cracked, worm-eaten. On right, fancy shipping tomatoes. Green above, ripe below.

Grading.—The U. S. Standards for tomatoes for sale for fresh use provide for two grades, U. S. No. 1 and U. S. No. 2. In grading it is important that no damaged fruit be packed (Fig. 96). The fruit is also sorted according to size.

The U. S. Standards for sweet peppers recognize three grades, U. S. Fancy, U. S. No. 1, and U. S. No. 2. Small fruits and any pods not properly shaped are discarded (Fig. 97).

U. S. No. 1 eggplant fruits are firm, fairly smooth, fairly well shaped, and colored and free from damage. U. S. No. 2 fruits are firm and free from serious damage.

Packing the Fruit.—A good packing shed is shown in Fig. 98. The best grade of green-wrap tomatoes is usually wrapped

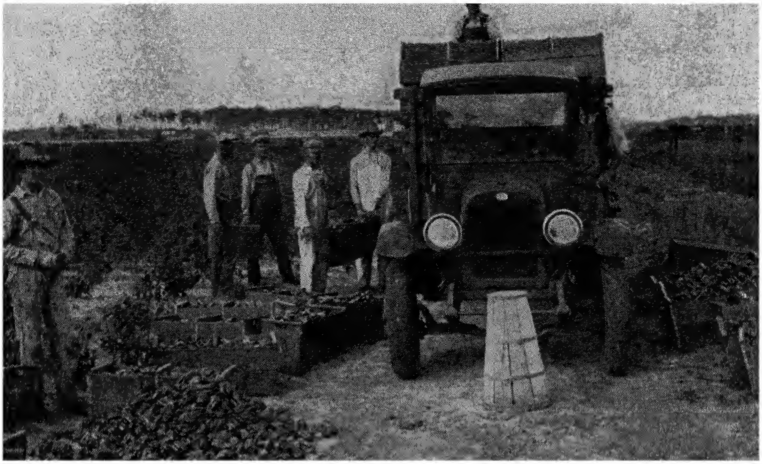


FIG. 97.—Hauling green peppers to the packing shed. Pile of culls in left foreground.

FIG. 98.—A good type of shed for packing truck crops, with seed and supply room at the center and stables beyond. It is used for implements when not otherwise in use.

in tissue paper and is packed in lugs. The lugs must contain at least 30 pounds of tomatoes when packed and marked. Lower grades and riper fruits are often sold in small crates or bushel hampers.

FIG. 99.—The tomato is a leading home garden vegetable. (U.S.D.A. Photograph by Hunton.)

The fruits of eggplant are wrapped in tissue paper and packed in bushel baskets or hampers or 1½ bushel crates.

Peppers are packed for the market in either crates or bushel hampers or baskets.

*

Job. 12. Marketing the Crop

Conditions Usually Found.—After these crops are packed for shipment they are mostly sold in three ways: (1) to local buyers; (2) to contractors who pay for the crop at the cars; and (3) consigned to commission men.

Aims.—Students should understand the best methods of marketing each of these crops.

Problems for Study and Discussion

1. What methods of marketing are used by the farmers of your community?
2. What is meant by consigning a car of tomatoes?
3. What are the functions of the commission man?
4. Of what value to farmers is the market news service?
5. What are the advantages of coöperative marketing?
6. What percentage of the local crop is shipped by express?
7. Debate: Selling to buyers on track vs. consigning to commission men.

Methods of Marketing.—Tomatoes, eggplants, and peppers are often shipped in ventilated cars. Tomatoes may be shipped under refrigeration but the expense is usually greater than the advantage is worth. Buyers come to the sections producing tomatoes, eggplants, and peppers and buy the crops which are graded and loaded in cars. (Fig. 100.) Often local dealers buy the crops in much the same way. The major part of the crop, however, is probably more often consigned by the producer to some commission man in a distant market.

Coöperatives Help Members

1. Find harvest hands
2. Buy supplies cheaper
3. Lower marketing costs
4. Locate open markets
5. Load cars together
6. Save freight costs
7. Attract larger buyers
8. Interest more buyers
9. Secure better grading

Coöperative Selling.—In growing centers, coöperative associations of a more or less permanent character are often formed for the purpose of marketing these crops. To be successful these associations employ a good manager who has the grading and packing inspected. He keeps in close touch with market conditions in the best cities. He may sell direct to jobbers, to

brokers, or to large consumers; but in some cases he consigns the crop to commission men. He attends to dividing proceeds properly among the growers. The cost of finding open markets is much less for each member than it would be otherwise.

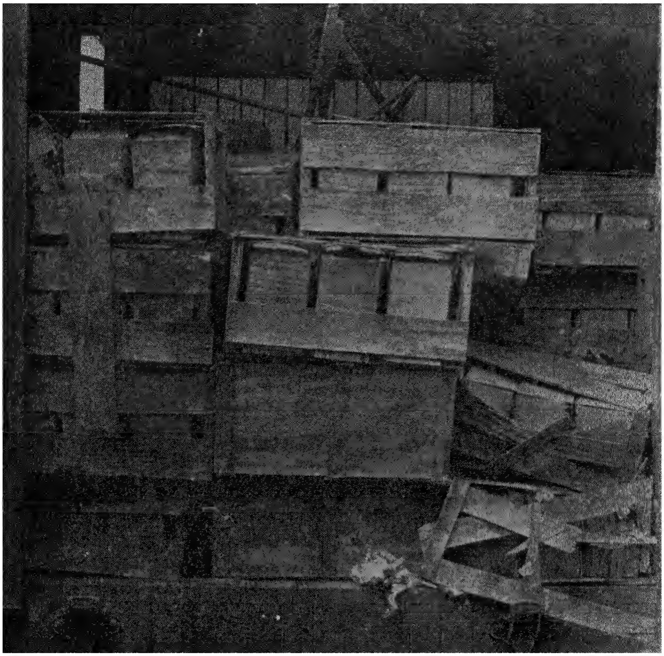


FIG. 100.—Tomatoes damaged in car because crates were improperly loaded.

Job 13. Keeping Records

Costs and Sales.—Plan to keep cost accounts, including labor records, miscellaneous expense records. (Figs. 101 and 102.) Then keep a record of sales and products used at home. Make a careful summary and calculate the net returns and the labor income from the enterprise. See suitable forms in the Melon Enterprise and draw others to suit tomatoes, eggplants, and peppers.

Calculations.—1. How many pepper plants are needed to set an acre if the rows are 3 feet apart and the plants set 18 inches apart in the rows?

2. In order to finance his tomato project a student paid $25 for the use of $450 for five months. At the same rate what would be the interest for twelve months? What rate of interest did he have to pay?

3. How many rods of wire fencing are required to fence a square 5-acre tomato field?

4. A student has a square 5-acre field of peppers with the rows 3 feet apart. He desires to apply 3,000 pounds of commercial fertilizer to the field. Where should he put each 200-pound bag of fertilizer in order for him not to have to move any? Show by diagram.

Fig. 101

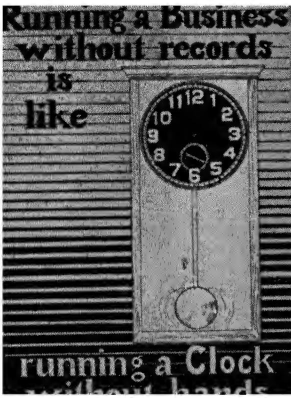


Fig. 102

Fig. 101.—Simple record systems are best.

Fig. 102.—Field records help to show true results at the end of the season.

5. A student declined an offer of $150 for an acre of tomatoes in the field. He harvested 135 crates of tomatoes at a cost for crates and labor of 50 cents per crate, and sold them for $1.50 per crate on the local platform. Did he gain or lose by refusing to sell his crop in the field, and how much?

6. Which is cheaper, kainit (12% potash) costing $14.50 per ton, or muriate of potash (48% potash) costing $47.50 per ton?

7. A plot of land, occupying two square rods, produced 12 crates of tomatoes. At the same rate how many crates would an acre produce?

8. A student applied 600 pounds of 4-8-4 (N-P-K) commercial fertilizer to an acre of peppers. He mixed this by using nitrate of soda (16%) at $60 a ton, superphosphate (16%) at $18 a ton, and muriate of potash (48%) at $48 a ton. Determine the cost of the 600 pounds.

9. A grower lost 20% of his tomato crop from wilt, not using a wilt-resistant strain. Compared with the yields and prices in problem 5, what was his loss per acre?

ENTERPRISES WITH BEANS

Collaborator: H. H. Zimmerley, Ph.D., Director, Truck Station, Norfolk, Va.

Tropical America is supposed to be the place of origin of the kidney bean, from which our common garden and field varieties, including the lima beans, have developed. At the time of the discovery of America the Indians were growing beans for use as food.

Beans are adapted to a wide range of conditions, both climatic and soil, but are not frost tolerant. Snap beans are grown for market or for canning, in considerable volume, in most states except in the Great Plains area. This is possible since relatively short periods of time are required for development of the beans for uses not requiring the full maturity of the seed. Dry-bean production is limited to areas having a mean August temperature not exceeding about 70° F.; therefore, the southern states are not generally suited to dry-bean production.

Analysis into Jobs.—An enterprise with lima beans or snap beans may be analyzed into the following farm jobs or units.

Job. 1. Determining Possibilities with Beans

Conditions Usually Found.—Beans may be grown successfully for the early market in practically all sections of the South.

Aims.—Growers should consider all factors carefully before deciding to plant beans.

Problems for Study and Discussion

1. What acreage is devoted to bean growing in your community?
2. What is the average yield to expect per acre for snap beans? For lima beans?
3. Find the cost of growing an acre of beans in your community.
4. What prices are usually received for the bean crop in your community?
5. How much capital must a person have to grow beans?
6. How long does it take to produce a crop of beans?
7. How much fertilizer is used by bean growers in your region?
8. What time is required for the production of snap bean crops in your region? For lima beans?
9. What are the local yields for each of these types of beans?
10. To what extent are local growers increasing or decreasing their bean enterprises?

Where Beans are Grown.—Both snap and lima beans can be grown in all sections of the South. The sections along the

Atlantic and Gulf coasts probably are most favorable for early beans because of the warm climate. The leading states in the total production of green snap beans are Florida, California, New Jersey, New York, North Carolina, Louisiana, Virginia, and South Carolina. All of the states in the South produce some snap beans for the market.

Lima beans are grown in all sections of the South, though to a much less extent for market than snap beans. Much of the dry lima bean crop is produced in California.

Yields to Expect.—The yields of snap beans vary with the season, and the fertility of the soil; however, growers may ex-

FIG. 103.—Student's project with snap beans. The crop was well fertilized, cultivated, and the rows slightly ridged.

pect to produce from 100 to 250 bushels per acre. The yield of lima beans is usually a little less than that of string beans.

Cost per Acre.—The total cost per acre for producing beans varies according to the cost of labor, the amount and kind of fertilizer used, the rent of the land, the amount of spraying done, and other factors. On an average, the cost of producing an acre of beans would probably range from $90 to $150. (Fig. 103.)

Prices to Expect.—The prices received for beans vary from one season to another. Prices depend upon such factors as the time of year, the supply of beans to be marketed, and the condition of the beans when they reach the market. Prices are usually high during the late fall, winter, and early spring months. For snap beans the price probably ranges from $1.00 to $4.50 per bushel, and for lima beans from $1.50 to $7.50 per bushel.

Time Required to Produce Beans.—The bean crop is produced in a very short time from planting. Snap beans usually

are ready for the market in eight to ten weeks and lima beans from ten to twelve weeks. Where the crop is planted in the early spring other crops may be produced on the same land after the bean crop is harvested.

Job 2. Choosing the Variety to Plant

Conditions Usually Found.—Growers usually choose one standard variety which is demanded by the markets.

Aims.—Growers should understand the advantage of selecting a standard variety.

Problems for Study and Discussion

1. Find what varieties of snap beans are grown for market in your community.
2. What varieties of lima beans sell well on the market?
3. Give reasons for and against the growing of green or of wax snap beans.
4. Make a list of the varieties of snap beans which sell well on the market.
5. Make a list of types and varieties for market and for your region.
6. What variety do you consider best for snap beans? For lima beans? Give reasons for your choice.
7. What local growers have made mistakes by growing varieties not suited to their market?
8. What varieties would you grow for a cannery?
9. To what extent can descriptions in garden catalogs be relied upon?
10. In what sense is the word *stringless* in the name of a variety deceiving?
11. Under what conditions should disease resistance in varieties be considered?

Activities.—From good catalogs tabulate the varieties of all types, showing color, season, size, type, etc.

Varieties of Snap Beans.—There are a large number of varieties of snap beans, as may be seen by looking in any seed catalog. Many different kinds of classification have been suggested for this large list. They may be classified as to their color, green or wax, or according to the growth, as pole or bunch.

The leading varieties as grown for the market include some of the green and some of the wax varieties. The leading varieties of green beans, with days for maturing, are: Giant Stringless, 61 days; Stringless Green Pod, 61 days; Refugee, 59 days; Valentine and Bountiful, 55 days. The last is a good, flat-podded early green variety, much grown in Virginia and North Carolina. The wax varieties include the New Davis White Wax,

53 days; Wardwell Kidney Wax, 56 days; Rustproof Wax and Black Wax, 49 days. A week less time is required for maturity from spring plantings than from fall plantings.

Pole beans are grown only in a limited way for the early market. They yield more but require at least two weeks more time for maturing. They are important for the local market. The leading variety is the Kentucky Wonder. In some places, the Cornfield variety is used, being a heavier yielder.

Varieties of Lima Beans.—The lima beans may also be divided into the bush and the pole varieties. The pole varieties are seldom used, except for the local market and for home gardens. Of the bush varieties planted for the market, a further division may be made according to the size of the seeds produced. Of the small-seeded type probably the Henderson Bush Lima (Dwarf Sieva, 79 days) is the best. Of the large-seeded type the Fordhook Bush Lima (83 days) is used more than any other one. This last-named variety sells well in the large northern markets. The Henderson Bush Lima (Dwarf Sieva) will probably sell better on the local southern markets, and is the principal canning variety.

Job 3. Selecting the Field and the Soil

Conditions Usually Found.—Growers usually select a sandy-loam soil for growing the early spring crop of beans.

Aims.—Growers should know how to select the best soil and field for beans.

Problems for Study and Discussion

1. What kind of soil is used in your community for growing beans?
2. What is the main advantage of a sandy-loam soil?
3. State the disadvantage of muck soil for bean growing.
4. Of what importance is drainage?
5. How would you want the bean field located in reference to roads and shipping facilities?
6. What relation has the location of the field to frost protection for early crops?
7. What local crops would you plan to follow with beans? Why?
8. Classify your local soils into early and latė types for beans.
9. Explain the meaning of "drouthy" soils. How are they remedied?

Soil for Beans.—Beans grow on a great variety of soils. Where the bean crop is grown for the early market, it is important to select a soil which will warm up early in the spring. Growers have found that a sandy loam soil is best in this respect.

Organic matter added to sandy soils will retain moisture better and be less "drouthy."

In certain sections beans are grown on muck soils. These soils produce good crops but there is more danger of frost on such soils in the early spring. Diseases are usually harder to control on muck soils.

To help in frost protection in the late fall or in the early spring, the growers in the extreme South select a "hammock" or sparsely timbered area for planting beans. The trees are killed but left standing to protect the bean crop from light frosts.

In all cases, a soil that is well drained should be selected. Beans will not produce well on wet, low lands.

The Rotation.—It is best to plan a rotation for beans so that diseases and insect enemies may be held in check. Beans should not be planted on the same land for about four years after a crop is harvested. Plan to have the crop follow a green-manure crop, a sod or cover crop turned under. Bean crops thrive on soils to which organic matter has been added.

Job 4. Obtaining Seed; Testing and Treating

Conditions Usually Found.—Practically all of the growers depend upon buying bean seed. Few farmers ever test seed.

Aims.—Growers should realize the importance of selecting good seed and of testing and treating seed before planting.

Problems for Study and Discussion

1. Find from what sources bean seed is obtained in your community.
2. How many farmers save bean seed?
3. How much seed would you need to plant an acre?
4. What is certified seed?
5. Where would you purchase bean seed?
6. How would you test bean seed for vitality?
7. What percentage of germination should be expected for good seed?
8. Give rules for selecting bean seed in your own field.
9. What is meant by roguing of plants?
10. Debate: Home production of seed vs. buying from dealers.
11. Describe the treating of seed with semesan.

Activities.—(1) Practice testing and treating bean seed. (2) Practice field selecting of bean seed.

Securing Bean Seed.—The general practice of growers is to purchase seed for planting every year. Seed should be purchased from a reliable firm, and not because the price quoted is low. Poor seed is high no matter what the quoted price may be.

The grower may save his own seed if he is prepared to take

the proper care of seed in storage. Seed to be saved should be selected from healthy plants and picked just as the pods are dry. After the beans are shelled they should be stored in a dry place because seed stored in a moist place soon loses its vitality. Treating the seed with carbon bisulfide in a closed container, at storage time, will kill weevils but often affects the germination.

Amount of Seed.—The amount of seed to provide depends upon the width of the rows, the size of the seed, and the method of planting. For the drill method of planting, more seed will be needed than for the hill method. Growers usually need from forty to seventy-five pounds of bean seed per acre, depending upon the factors just mentioned.

Testing Bean Seed.—Seeds are tested for vitality as recommended under the Melon Enterprises. Treating seeds with semesan dust may aid in germination, and will aid in controlling seed-borne diseases such as anthracnose. Soaking, unless the seed are planted immediately, is a questionable process.

Job 5. Preparing Soil for Beans

Conditions Usually Found.—Soil for beans is usually well prepared.

Aims.—Students should know the importance of a well-prepared seed-bed, and should know how to prepare it economically.

Problems for Study and Discussion

1. What implements are used in preparing the soil for beans?
2. At what time of the year is the soil prepared?
3. Under what conditions is fall plowing advisable? When not best?
4. Discuss the depth of plowing soil for beans.
5. At what distances apart are bean rows spaced?
6. What is meant by a bare-fallow period before planting?
7. Give the steps followed by local growers in preparing soil for beans.
8. How is organic matter supplied?

Preparing the Soil.—Beans should have a well-prepared seed-bed. The soil is usually turned with a turning plow to the depth of six to eight inches. In many places it is best to run over the land with a disk harrow just prior to planting. The soil should be prepared several weeks before planting time, but the length of time varies in different sections. Do not prepare the soil while it is wet. During these several weeks the soil should be harrowed several times. This is called the bare-fallow period.

The benefits of several harrowings a few days apart are: the control of weeds and insects, the control of moisture, the warm-

ing of the soil, the settling of the lower soil, the mingling of soil with green manure plowed under earlier, and the making of a good seeding surface (Fig. 104).

The rows are spaced at different widths, varying from eighteen to thirty-six inches. They may be marked with a special marker opening slight furrows, or they may be marked with the planting machine at planting time.

Fig. 104.—Disking, laying off rows, fertilizing soil, and planting snap beans.

Job 6. Planting the Bean Crop

Conditions Usually Found.—Bean seed is usually planted in drill rows and either dropped by hand or with a seed drill.

Aims.—Methods of planting beans in order to secure good stands should be understood by growers.

Problems for Study and Discussion

1. What methods are used for planting beans in your community?
2. How deep should the seed be planted?
3. How much seed is needed per acre?
4. How long before planting should the rows be marked off?
5. How would the pole-bean crop differ in rate of planting from the bush varieties?
6. How are beans planted in your community, by hand or with a seed drill?
7. Give price and describe the working of a seed drill.

8. Give distances and rates of planting for snap beans and for limas.
9. At what time of the year would you plant beans?
10. Why would you plant the small, early varieties closer together than the late varieties?

Activities.—Plant beans at different rates and at different depths for comparison of results. Compare also the hill and the drill methods of planting.

Methods of Planting.—Where a grower has just a few acres of beans to plant the hand seed drill is generally used. Seed may be dropped by hand. Drilling gives a more uniform stand and is faster. For large commercial plantings the grower usually uses a regular corn planter with special bean-planting plates.

Growers have used the hill and the drill systems of planting. Practically all tests have proved that the drill system is better for the production of beans. In planting the drill rows, the seeds are dropped at intervals of four to eight inches.

Distance between Rows.—This depends upon the fertility of the soil and the method of cultivation to be followed. On muck soils the rows may be eighteen to twenty-four inches apart, and the cultivation may be given by wheel hoes. Where the cultivation is to be given by the use of horse-drawn cultivators, the rows should be spaced from thirty to thirty-six inches apart.

Time to Plant.—Beans will not withstand heavy frosts. They are planted after the danger of frost in the spring so that they will mature before frost in the fall. In Florida, beans are planted in many places during the fall and winter months. The winter crop there is produced on the islands and protected areas of the coasts. For the different sections of the South the time for planting beans is from February to May.

Job 7. Providing Plant Food; Applying Fertilizers

Conditions Usually Found.—Farmers usually apply commercial fertilizers for beans.

Aims.—The student should know how to select and how to apply good fertilizers for beans.

Problems for Study and Discussion

1. What kinds of fertilizers do the farmers of your community use for beans?
2. Find what formula is recommended in your community.
3. At what rates are commercial fertilizers applied?

4. How many farmers in your community home-mix fertilizers or use unmixed materials?
5. What are the advantages of home-mixing fertilizers?
6. How is organic matter usually provided?

Activities.—Practice home-mixing of fertilizers for beans. Practice applying these.

Fertilizers for Beans.—Beans mature in two or three months. This fact makes it very important that all fertilizers used be readily available. In many places the practice is to apply the fertilizer before planting. From five to ten loads of barnyard manure to the acre, applied before the soil is plowed, is very beneficial for beans.

If no barnyard manure or no green manure is used, a complete fertilizer is recommended. A fertilizer which analyzes 4 to 5 per cent nitrogen, 8 to 10 per cent phosphoric acid, and 4 to 5 per cent potash is applied at the rate of 400 to 800 pounds per acre.

Many growers find it desirable to mix their commercial fertilizer at home or to use unmixed materials. If large quantities are needed, it may pay to home-mix. Unmixed materials are used to supplement manures because a complete commercial fertilizer may not be needed.

Job 8. Cultivating Beans

Conditions Usually Found.—Beans are given frequent, shallow cultivation by successful growers.

Aims.—The value of good cultivation and how to cultivate should be understood by growers.

Problems for Study and Discussion

1. What implements are needed for cultivating beans?
2. When would you commence to cultivate the bean crop?
3. Of what value is cultivation?
4. How often should you cultivate beans?
5. At what time of the day is it best to cultivate?
6. When should the cultivation be discontinued?

Cultivating Beans.—Beans may be cultivated with hand tools or with riding cultivators. The cultivation should start soon after the beans come up and usually three or four cultivations will be sufficient. This should be done in the afternoon or after the dew dries in the morning, as cultivation while the beans are wet may cause the spread of anthracnose disease. All cultivations should be shallow.

On muck soil the crop is often cultivated with hand implements such as wheel hoes (Fig. 105), hand hoes, or hand rakes.

Cultivation may be continued until the plants are in bloom or even until they have young beans ready to pick.

Reasons for Cultivating Beans.—There are quite a number of reasons for cultivating the bean crop. Among the reasons which may be mentioned are: (1) to destroy weeds and grass; (2) to form a dust mulch to conserve moisture; (3) to provide air spaces for warmth of the soil; (4) to assist in making plant food available; and (5) to kill insects.

FIG. 105.—The use of a wheel-hoe in project work may increase the "labor income."

Job 9. Controlling Diseases and Insects

Conditions Usually Found.—Farmers have to fight both insect and disease enemies of beans.

Aims.—The student should be able to identify insects and diseases and know how to control them.

Problems for Study and Discussion

1. Make a list of the bean diseases in your community.
2. Be able to recognize each of these diseases.
3. How may each of these diseases be controlled?
4. Make a list of the insect enemies.
5. Be able to identify each of these insects.
6. How may each of these insects be controlled?

Diseases.—Beans are attacked by a number of plant diseases which may cause serious damage. Probably the most destructive of these diseases are anthracnose, rust, blight, and mosaic.

Anthracnose attacks the stem, leaves, pods, and dry seeds. The spots on the bean pod are irregular in shape and pink in

color, and a dark-red edging may be seen. The disease may be so severe that no beans will be produced. It is carried by planting seed which have the anthracnose spores on them. Seed should be saved only from fields entirely free from this disease, and purchased seed should come from areas free from anthracnose. Treat before planting. Beans may also be sprayed with Bordeaux mixture but it is only partially successful.

Rust is common in many different sections. It may be noticed on the leaves as reddish-brown spore masses. The leaves attacked turn yellow and later dry up and fall from the plant. The disease may be held in check by using a large amount of potash in the fertilizer and by selecting varieties of beans which are rust resistant.

The Bacterial Blight.—This disease produces irregular spots which at first appear as water-soaked areas, and later turn brown. On the bean pods the disease starts by causing slightly raised spots which are irregular in shape and amber in color. The disease is hard to control, except by following methods of prevention. Select only seed from plants known to be free from this disease, and treat all seed with semesan.

Mosaic causes light and dark green splotches on the leaves. The disease, so far as is known, is carried on the seed. The only control measure that is known is the selection of seed which is free from this disease. Treating seed may help.

Insect Enemies.—Beans are injured by several different insects. Probably those causing the most damage are the Mexican bean beetle, the leaf beetles, bean thrips, and bean aphids.

The Mexican bean beetle is reddish in color, with six black dots on the wing covers. The insect does its damage by eating holes in the leaves. It is by far the worst insect enemy of beans, as it is very destructive, often destroying large acreages. It may be controlled by spraying with magnesium arsenate, provided that the leaves are sprayed from the under side as well as from the top. Dusting frequently with magnesium arsenate mixed with nine parts of lime dust will kill the beetles. Apply dust when plants are wet with dew. Keep new growth poisoned. Avoid using arsenate of lead on beans, as it burns the foliage. Spraying with barium fluosilicate is very effective and does not poison the beans for human use. (Fig. 106.)

The bean thrip is grayish in color. It does damage by sucking the juice from the plants. Where this insect does considerable damage it may be controlled by spraying with nicotine sulfate.

The bean aphids are small, black plant lice. They damage the crop by sucking the juice from young plants. The control measure is the use of nicotine sulfate.

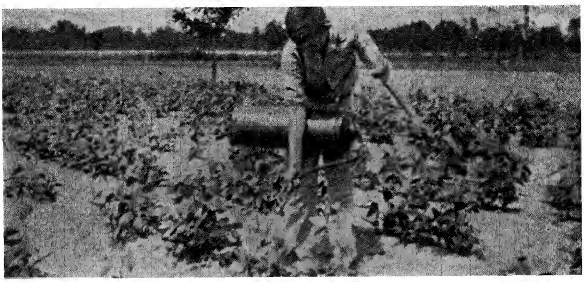


FIG. 106.—Student controlling bean beetles by spraying the project crop with barium fluosilicate.

Job 10. Harvesting, Grading, and Packing

Conditions Usually Found.—Beans are picked by hand and packed in special crates for shipment.

Aims.—How to pick, grade, and pack beans should be understood and practiced by all growers.

Problems for Study and Discussion

1. At what stage would you pick snap beans? Lima beans?
2. What price is paid per hamper for picking beans?
3. Discuss time of day and weather conditions for picking.
4. How are beans graded for the market?
5. What grades are established? Describe each.
6. What different crates are used for shipping beans?
7. Under what conditions are limas shelled for market?

Activities.—Practice harvesting, grading, and packing beans. If possible, visit a large field and take notes of how crews of operators are handled.

Time to Harvest.—Snap beans are harvested just before the pods reach the normal size and before the seeds begin to mature. If picked too early there is a great loss to the grower, and if the bean seeds mature the pods become tough and stringy. Snap beans should be tender and easily snapped when harvested.

Lima beans in the South are harvested just as the seeds reach

nearly the normal size, but before the hulls begin to ripen. In other sections, the seed pods are allowed to ripen and the beans are marketed dry.

Methods of Harvesting.—Both the snap and the lima beans are picked by hand. (Fig. 107.) The picker should exercise

FIG. 107.—Bean project at harvest time, showing good yields. Well-made hampers of bushel size are used.

care in picking not to injure the young pods and blossoms. Snap beans will need to be picked every three or four days and lima beans about once a week. The pickers usually use hampers in which to put the beans as they are picked.

Grading Beans.—Growers give very little attention to grading beans. The picker should discard all diseased, worm-eaten, or misshapen pods. Over-ripe pods should be discarded or separated. If this is done, little other grading will be necessary.

Packing Beans.—The common crate for shipping beans in the South is the bushel hamper. Other crates are used occasionally. The hamper should be given a shake two or three times during the packing in order that the beans may fill the hamper well enough to prevent damage in transit. After the hamper is packed, the top is put on and wired to hold it in position.

Job 11. Marketing the Bean Crop

Conditions Usually Found.—Growers consign express shipments to commission houses. Car-lot shipments are also made.

Aims.—The grower should know how to market his bean crop to best advantage.

Problems for Study and Discussion

1. How many farmers in your community sell beans coöperatively?
2. What are the advantages of a coöperative association?
3. How may a grower secure market information?
4. What is meant by consigning beans to a commission house?
5. What method of marketing do you consider best for beans?
6. Find whether or not it would pay to ship beans under refrigeration.
7. Compare the costs of refrigerator shipments; ordinary freight; and express.
8. Compare selling through commission men and brokers and selling direct to dealers such as jobbers.

Marketing Beans.—Beans may be shipped to market in car lots but the usual method for the earliest crop is to ship in bushel hampers by express. Local buyers are found in certain localities where many acres are grown. The buyers stand all the market risks and pay cash to the growers at the tracks. Much of the bean crop is consigned to commission merchants in market centers where the product often meets the very sharpest competition, and many growers are disappointed.

Many communities have formed coöperative associations for marketing beans. If managed right, the coöperative association can be of much help to the growers.

Job 12. Keeping Records

Records are kept as recommended for the Melon Enterprises.

Bean Calculations.—1. Secure the local price of snap bean seed and determine the cost for 5½ acres if 50 pounds are to be planted per acre.

2. A young man invested $75 for growing an acre of beans. At the end of 10 weeks he sold his crop for $116.25. What percentage of profit did he

make on his investment? If the money could bring the same interest each 10 weeks for a year, how much money would he then have?

3. In order to spray two acres of beans, a student hired a man with a power spray pump, who charged \$5 per acre. If the spray material cost the man \$1.25 and the use of the machinery is \$1.75, what did the man receive per hour for his labor, if the work took 2 hours and 12 minutes?

4. Secure the express rate from your station to New York for a hamper of beans. Find what a student would receive above express for the following sales from his acre:

110 hampers at \$1.95.
115 hampers at \$1.35.

5. The cost of growing the crop was \$67.50, and the cost of marketing was 5% of the gross sales. Find his net returns on the crop in problem 4.

Inoculating Legumes

1 peck soil from crop
Mix ½ peck in tub of water
Drain off water for use
Add 1 ounce liquid glue
Wet all seed needed
Sift rest of soil on seed
Spread in shade to dry
Plant within three weeks

OKRA ENTERPRISES

Collaborator: J. G. Woodroof, Ph.D., Formerly Professor of Horticulture, Georgia Experiment Station.

Okra is a hot-weather perennial, and its production for market is confined almost entirely to the southern states.

It is not frost tolerant. The plant requires a relatively long season for development and grows best where night temperatures as well as daytime temperatures are relatively high. It is found occasionally in home gardens in some of the northern states.

Analysis into Jobs.—The following jobs include the teaching units in an okra enterprise.

Job 1. Determining Possibilities with Okra

Conditions Usually Found.—Okra is grown throughout the South, but is little known in other sections. It is grown very generally in the home garden but, as yet, is not grown to any great extent for commercial purposes.

Aims.—The student should understand the climatic requirements and economic factors necessary in the growing of okra.

Problems for Study and Discussion

1. How is okra most commonly used? Why?
2. Determine the labor needs and distribution.
3. Discuss the expense of growing okra.
4. What are the probable returns?
5. Determine the sections in which okra is grown commercially.
6. At what temperature does okra thrive best?
7. What is the length of season required for growing okra?
8. What are the bad effects of too much heat on the maturing crop?
9. Compare okra with other vegetables as to food value.
10. Compare the demand and prices for okra with those of other vegetables.

Labor Needs.—Okra belongs to the same family and demands about the same attention as does cotton. The harvesting is regular and is extended over a long period, from the time of first bearing until the first frost. (Fig. 108.)

Money Required.—Okra is not an expensive crop. When grown on soil in a high state of cultivation less fertilizer and possibly less labor for cultivation are required than on poor soil.

Probable Returns.—A recent census report gives the value of okra grown for sale in the United States as having an average value per acre of $119. Yields range around 200 bushels of product per acre.

Uses of Okra.—Okra is used mainly as a green boiled vegetable. Other important uses are in soups and stews. When

Fig. 108.—Student's okra project. Harvesting must be done frequently to insure a tender product. The white velvet variety is tall, early, and productive.

cooked, okra exudes a large quantity of mucilaginous substance, which makes the vegetable one of peculiar texture. It may be canned or dried for use in soups.

Estimated Cost of One Acre of Okra

Seed (10 lbs.)	$ 5.00
Preparation of land	10.00
Planting	2.00
Fertilizer	18.00
Side-dressing of fertilizer	4.00
Cultivating	25.00
Harvesting	35.00
Containers	40.00
Total	$139.00

Required Rainfall.—Okra thrives best on a moist soil, although it does not require excessive moisture. Dry weather after planting is likely to cause a poor stand. Cotton insects and diseases, which increase during extreme rainfall, show like increases and effects in okra growing.

Temperature.—Okra must be grown in hot weather and will not thrive in regions having a short growing season, 90 to 140 days being required from planting, and cold nights. The temperature should be 80 or 90 degrees F. during the day, followed by warm nights. Too much heat at maturing time is likely to make the product fibrous or woody and to likewise delay harvest.

Growing Period.—In warm regions two or three plantings are made three or four weeks apart. Recent trials show that one planting gives good results provided that the product is continuously picked very young. From 90 to 140 growing days after planting, under favorable conditions, are required to grow okra ready for cutting. If the pods are not allowed to mature, the bearing period is longer and is practically continuous.

Soils for okra should be rich and well drained. The crop should make a thrifty growth in order to produce a tender product.

Job 2. Preparing Soil; Fertilizing

Conditions Usually Found.—Okra grows well and produces under a wide range of fertilizing conditions. Soil prepared as for corn or cotton will produce okra well.

Aims.—The soil preparation and the fertilizer requirements for okra should be known.

Problems for Study and Discussion

1. Determine the kind of fertilizer best for okra in your section.
2. Report opinions of growers regarding different kinds of fertilizer.
3. How much fertilizer per acre is used by successful growers in your section?
4. Report the different methods and times of applying fertilizers.
5. Discuss depth and time of plowing for okra.
6. How is organic matter most economically supplied to the soil for okra in your section?
7. Discuss harrowing and planking of soils for okra.

Kinds and Amounts of Fertilizer.—From 600 to 800 pounds of a 5-10-5 (N-P-K) fertilizer are required for thin soils. Less potash is required on heavy soils than on light soils. A side dressing of quickly available nitrogen should be added at the

rate of 50 to 75 pounds per acre about twice during the summer. Nitrate of soda or sulfate of ammonia may be used.

Organic matter may be supplied by turning under plenty of green manure or by a heavy application of barnyard manure before the soil is plowed for okra.

Soil Preparation.—Soil should be plowed well and at a good depth several weeks before planting. During this period the soil should be harrowed two or three times to sprout and kill weeds, warm the soil, save moisture, and prepare a good seed-bed. Planking or rolling the surface should not be necessary unless the soil is cloddy.

Job 3. Choosing Varieties; Preparing Seed

Conditions Usually Found.—The market demands usually determine the variety to be planted. All other things being equal, a variety of dark green color and one as free from fuzz as possible is selected. Seed is commonly saved by growers or purchased from dealers. Treating and testing seed are seldom practiced.

Aims.—The best varieties of okra to grow, how to procure good seed, and how to test and treat seed should be known.

Problems for Study and Discussion

1. Determine the types and varieties of okra grown in your section.
2. Report opinions of growers and compare the best varieties.
3. Discuss the value of roguing if seed is selected by the grower.
4. Determine the variety requirements in your markets.
5. Report the variety qualities demanded by canners.
6. Discuss the methods and value of treating seed before planting.
7. Describe the testing of seed.

Okra Types and Varieties.—The three general types and their variety subdivisions are here arranged:

Types	*Varieties*
Dwarf green	Long pod, and short pod
Tall green	Long pod, and short pod
Lady finger	White pod, and green pod

Several variety names are given in catalogs. Perkins' Mammoth is popular for shipping and for canning. The pods are long and dark green, nearly free from fuzz. White Velvet is tall and early, with white, smooth pods. (Fig. 108.) Dwarf Green is early, pods short, and deep green in color.

Selecting Good Seed.—Some varieties are mixed and do not produce uniform products. Growers sometimes find it advisable

to select seed at home. In this case, close roguing and very close selection give best results.

Treating Seed.—Okra does not germinate readily. Treating seeds before planting aids germination. Use one-fourth of one per cent semesan solution and soak seeds for one hour. Then soak seed in "milk" warm water until the seed-coats split (usually thirty-six to forty-eight hours) and plant immediately, without exposure to heat or cold.

Testing Seed.—Growers find that seed testing pays. Poor lots of seed should not be planted. Test seed by the rag-doll method described for melons.

Job 4. Planting and Cultivating Okra

Conditions Usually Found.—Okra often fails to germinate evenly and poor stands are often seen. Cultivation as for corn or cotton is quite common.

Aims.—The best methods of planting and thinning and of repeating to keep a good crop succession, and the best methods of cultivation should be known.

Problems for Study and Discussion

1. At what season should your first planting of okra be made?
2. Give distances and rates for planting.
3. What are the best distances for thinning tall and dwarf types of okra?
4. When should thinning be done?
5. Compare cotton and okra as to planting and cultural requirements.
6. Give directions for cultivating okra to give best results.
7. Compare okra and cotton blossoms and fruit.

Activities.—Determine by trial the best temperature and moisture conditions for sprouting okra seed.

Planting Okra.—This crop thrives in warm summer weather and does not withstand frosts in spring or fall. As with cotton, growth is best when nights are warm. Germination is slow and poor stands may result if the soil becomes hard before the plants are up. Plant in good soil, using soaked seeds, and harrow or rake the rows if the soil tends to crust. Planting radish seeds with okra will help to break the crust and mark the rows.

Rows should be spaced three feet apart for dwarf types and four or four and a half feet apart for tall types. Close pruning allows closer planting. From ten to fifteen pounds of seed per acre are required. Seed may be planted with any garden drill or by hand. Seed should be covered about one inch deep in heavy soils or a little deeper in loose, open soils.

Thinning the Plants.—Unless seed is tested and treated so that rather perfect germination may be secured, the planting in rows should be close enough to require thinning. The plants should be thinned to two feet for tall varieties and one foot for dwarf varieties. This should be done with a hoe as soon as the plants form their second pairs of leaves.

Cultivating Okra.—Level culture is usually practiced. Harrow the soil after planting so that no weeds will start ahead of the okra. Begin cultivation as soon as the rows can be seen. Continuous cultivation is necessary. Use the implements required for corn or cotton. Some hoeing is advisable if grass or weeds are in the row.

Job 5. Controlling Insects and Diseases

Conditions Usually Found.—Okra is not attacked by many insects or diseases. Wilt diseases are sometimes very serious.

Aims.—The insects and diseases of okra should be known and their methods of control should be understood.

Problems for Study and Discussion

1. What diseases affect okra in your community?
2. What insects seriously attack okra in your locality?
3. Report opinions of growers regarding methods of control of insects and diseases.
4. Report cases of diseases developing in shipments.
5. Briefly describe the common insects and diseases.

Insects.—Few insects other than those attacking cotton attack okra. Okra is a host plant for the cotton boll weevil. For this, follow the same method of control as for cotton. Aphids and leaf-eating insects have been found on okra but they usually cause little damage.

Diseases.—There are two wilt diseases that attack okra. These are soil-borne diseases and can be reduced by planting wilt-resistant varieties and by proper rotation of crops. Soils infected with cotton wilt should not be planted to okra. The pods of okra are sometimes affected by pod spot. This disease seldom occurs on fresh soils.

Job 6. Harvesting and Marketing

Conditions Usually Found.—Unless grown for seed, okra pods are cut about three times a week during the best bearing season. The crop is marketed both locally and by shipments. It is also sold to canneries.

Aims.—The best methods of harvesting, handling, and marketing should be understood.

Problems for Study and Discussion

1. Observe and determine when okra is ready for harvesting.
2. Report community practices as to how harvesting is done.
3. Determine the harvesting cost per commercial package.
4. What type of package is used?
5. Report how okra is marketed in your section.
6. How often is okra cut by the best growers?
7. How much of the local crop is bought locally or by neighboring markets?
8. To what other markets is the crop shipped?

Condition for Harvest.—Fresh okra should be harvested and marketed while it is tender and crisp. (Fig. 109.) It is usually cut when the pods are about four days old and before they are quite fully grown. The length of pods of different types may serve as a guide to pickers who become familiar with the type. Pods having hard tissue or woody seeds should be discarded, but should not be left on the plants. During the harvesting season pods too old for use should be removed, as they devitalize the plants. Care in this regard will keep plants producing a good crop continuously.

Uses.—The young, tender pods of okra are used mainly as fresh vegetables. Large quantities are used in soup mixtures. In southern regions very little of the early crop is canned or dried. Later in the season canneries consume much of the crop.

How to Harvest.—Pods may be cut with a sharp knife. By cutting away from the stalk less damage occurs. Contact with okra causes an itching or stinging sensation of the hands, which may be prevented by wearing gloves and long sleeves while working with it. Pods are sorted as cut, but some culling afterwards may be necessary if untrained pickers are used. (Fig. 110.)

Seed Production.—Ripe pods for seed are allowed to dry on the stalks. If a variety is used that shatters easily, care must be taken to harvest just at the right time. Seed harvesting may begin about the middle of August and continue until frost. Pickings should be made as soon as several pods ripen on a stalk. Pods must be kept dry and well aired until the whole crop is ready to be threshed. No threshing machines for okra have been developed. Dried pods are usually flailed, each variety being kept separate. For seed, each variety should be grown

considerable distance from other varieties, to prevent crossing of the pollen.

Containers.—Either half-bushel or bushel baskets may be used for shipping okra. The crop is sometimes packed in six-basket carriers, such as are used for tomatoes.

FIG. 109.—Okra is a continuous bearer. New blossoms and pods are formed toward the top of the plant as growth continues. The plant is checked if the oldest pods are not removed often.

Marketing.—The marketing of okra follows the same general plan as the marketing of other vegetables. Much of the okra crop is shipped by express or in "mixed" cars with other vegetables.

Large manufacturers of soup products consume large quantities of okra. Canning companies have large areas of okra grown on contract. The pods are shipped in a salt solution to the cannery. The shipments are often made by water route because of the great weight and cheaper rate. Nearness to water

FIG. 110.—Extra Early Dwarf variety of okra. A large project using hired packers. Bushel hampers are used for shipping.

routes largely determines centers of production of okra on such contracts.

Job 7. Keeping Records

Records are kept as recommended for the Melon Enterprises.

Okra Calculations.—1. By picking his okra often a grower secured 600 crates of No. 1 product, selling at $3.00 a crate. His neighbor was careless about picking and secured 400 crates, selling at $2.00 a crate. Allow $1 per crate for picking, containers, and marketing. How much did the crops net their growers?

2. Find the percentage of loss of the careless grower in problem 1.

3. A student turned under organic matter in the form of a heavy growth of green manure, which he found cost him $2.50 an acre for seed and sowing. His neighbor bought 4-8-4 fertilizer at $38 a ton and applied it at the rate of 600 pounds per acre. If their yields of okra were equal, how much per acre did the student save by his method?

4. If in problem 3 the student's harvest was 600 crates of okra, and the neighbor's yield, cut short by drouth without organic matter in the soil, was only 425 crates, what extra percentage did the student gain due to his method?

5. Consider yields as in problem 4 and prices at $2 per crate net above cost of containers, labor, and marketing. How much per acre did the student and neighbor each receive for their crops?

6. From results of problems 3, 4 and 5, calculate the total advantage of the student over his neighbor.

ENTERPRISES WITH SWEET CORN, SWEET POTATOES, AND IRISH POTATOES

Crops of corn, sweet potatoes, and Irish potatoes are commonly treated as field crops. Full treatments have been given to these three crops on the job-analysis basis in *Southern Field-Crop Enterprises,* a companion volume in this *Series.* Because of this fact no full treatments are given to them in the present volume.

SWEET CORN ENTERPRISES

This crop is grown for market to some extent in all southern states. Much early sweet corn is shipped to northern markets. A grower should strive to produce 50 to 75 bags of marketable ears per acre. The cost of growing may vary from $30 to $70 per acre. It should yield the grower from $1 to $4 per bag. Varieties should yield in 60 to 100 days from planting time.

Varieties of sweet corn most often grown are Golden Cross Bantam, Country Gentleman, and Stowell's Evergreen. Read descriptions in catalogs. Field corn is often grown for market roasting ears in southern regions because the ears are larger. Only one variety of early, medium, and late each season should be grown in a community.

Soils should be rich for corn. Good preparation, by several harrowings a week apart, is best. (Fig. 111.) Planting can take place when danger of frost is past. Thin plantings to two or three stalks to a hill. Practice very clean cultivation. Keep enemies in check. Feeding the crop will give good returns. Use plenty of fertilizer. Side dress with nitrate of soda in light soils.

Harvest in the milk stage. Snap ears with the husks left on, and pack in open mesh bags to prevent heating. Bags hold from 4 to 6 dozen ears.

The use of the mesh bags has replaced the use of crates, formerly the most popular container for sweet corn. The mesh bags are much cheaper and allow better ventilation which is very important in maintaining the quality during shipment of the corn to distant markets.

Selling is often to local buyers. Much corn is consigned to commission men. Some is sold coöperatively. After ears are sold the stalks make good feed for livestock, as soiling, as fodder, or as ensilage.

Corn References.—U. S. Farmers' Bulletins 414, 1149, Corn Culture; 553, Popcorn; 739, Cutworms; 891, Root aphis; 915, Weevil waste; 950, Rootworms; 1025, Cornstalk borer; 1175, Seed corn; 1124, 1176, Diseases; 1310, Ear worms; 1548, 1562, Corn borer. Obtain corn bulletins from each southern state and from leading corn states. See field-crop books. See *Field-Crop Enterprises* (Lippincott) in this *Series*. See *Corn Growing*, by Wallace and Bressman (Wiley).

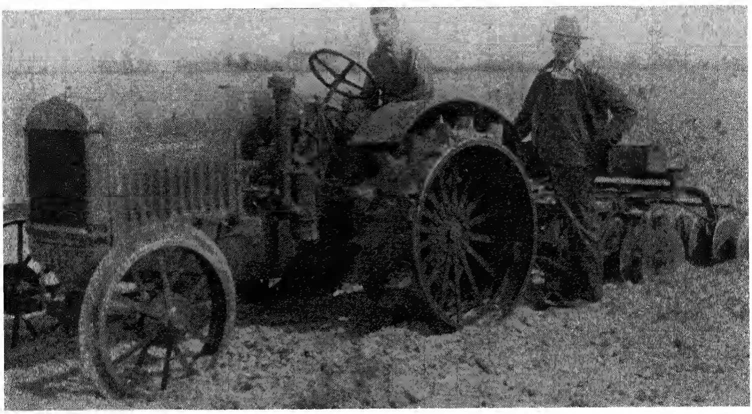


FIG. 111.—Vocational student using tractor in double disking soil for his project with sweet corn.

Corn-Crop Mechanics.—Make racks suitable for hauling crates of roasting ears. Repair and adjust the planters, cultivators, markers, and other implements and tools. Make up crates from flat stock. Make a tester box for seed corn. Make a book case and desk for a home study and office.

Corn Activities.—(1) Collect and save ears of early, medium, and late varieties of corn. (2) Select in the field seed corn for the next crop and store it free from insects. (3) Compare bare-fallow methods before planting with planting soon after plowing. (4) Compare results from planting corn at two different rates. (5) Try home-mixed fertilizer in contrast with "patent" mixtures and note results and costs. (6) In a project, test the value of cross-harrowing of young corn. (7) Treat seed corn to prevent injury from gophers and birds. (8) Test seed corn by the rag-doll method. (9) Contest with others in presenting ears in attractive form for market. (10) Contest with others in selling corn successfully. (11) Fill a set of record blanks, using data from a good grower.

SWEET POTATO ENTERPRISES

Probably more than 90 per cent of the crop is grown in the southern states, as a long season, about four months, is required for maturing the crop. The costs per acre, including marketing, vary from $60 to $150. Average yields by states range from 65 to 150 bushels per acre; and prices at the farm averaged $2.00 in 1945. Most labor is required at setting and harvest times.

Varieties of the dry-flesh type are Big Stem Jersey, Yellow Jersey, and Gold Skin. Varieties of the moist-flesh type are Porto Rico, Nancy Hall, Dooley, Triumph, Pumpkin "Yam," and Southern Queen. See descriptions in catalogs.

Soil should be light and warm but well supplied with plant food in available form. Well-rotted organic matter is important. Rotation of crop is always advisable. Prepare soil well, as for truck crops; have it loose at planting time. Ridging before setting plants is common. Work the ridges down with a drag. Fertilize heavily before and after planting with well-balanced fertilizers.

Plants are grown in manure-heated hotbeds by bedding seed roots under a layer of sand. Allow 24 square feet per bushel of seed roots. This should produce about 3,500 plants. Seed and beds should be treated with corrosive sublimate or semesan before bedding begins. Select seed free from black rot. Plants are set by hand or by machine in rows 30 to 36 inches apart, with the plants 18 to 24 inches apart in the rows.

Care of the growing crop is important. Cultivate often, and keep rows free from weeds. Ridging the rows toward the end of the cultivation season is commonly practiced. Growers should compare ridging with level culture if soils are sandy. Black rot is the worst disease. Healthy seed and plants on clean soil are the best means of prevention. Sweet potato weevils are often very serious. Treat seed before planting. Plant on clean fields. Rake up vines and feed them to livestock. Hogs should clean up the cull roots in the field soon after harvest.

Harvesting must be done with care to avoid injuring roots. Forks, plows, or diggers are used after vines are cut and removed. Harvest just before frost. There are four federal grades, based on size. Grading is chiefly done in the field. The crop is shipped in hampers, crates, or baskets. Crates are often preferred for the early crop.

Curing and storing of sweet potatoes is done in houses that are provided with double walls and in which the heat and ventilation are under control. Stoves or other means of heating for about two weeks, when the crop is first placed in the house, are needed. Crops thus saved are often sold at better prices later.

Marketing through pooled shipments is becoming more common. Federal inspectors are aiding much in the standardizing and marketing of this crop. Selling through commission men is perhaps less common than formerly.

Sweet Potato References.—U. S. Farmers' Bulletins 999, Growing; 1059, Diseases; 1267, 1442, Storage. U. S. Department Bulletins 1158, Sweet potato syrup; 1206, Marketing. Obtain state station publications on sweet potatoes. See *Southern Field-Crop Enterprises* in this *Series* (Lippincott), and other field-crop books. See special books on sweet potatoes by Thompson (Judd), and by Hand and Cockerham (Macmillan).

Sweet Potato Mechanics.—Make propagating beds; vats for treating seed roots; crates and field lugs; storage house; storage racks and containers; racks for truck and wagons for hauling crates and lugs; and planting tongs. Repair field machinery.

Sweet Potato Activities.—(1) Collect samples of different varieties and contest in identifying them. (2) Treat seed roots by different methods and compare results. (3) Contest in successfully growing plants in hotbeds. (4) Prepare light soils by ridge and level methods and compare results. (5) Contest in setting plants by same method. Try different methods. (6) Fertilize the crop in two ways and compare results. (7) Practice grading and packing sweet potatoes. (8) Draw plans for a curing house of a size to suit several local growers. (9) Inspect houses at curing time and assist in the curing. (10) Assist in loading cars; prepare bills of lading.

IRISH POTATO ENTERPRISES

Early Irish potatoes are grown extensively during the winter and very early spring in the warmer parts of the South bordering the Atlantic and the Gulf. Crops for local use and for storage are grown in the cooler parts of the South. The six leading potato states in the southern group are Virginia, North Carolina, Tennessee, Florida, Alabama, and Texas. All southern states grow from one to ten million bushels.

Costs of production average about $100 to $175 per acre, including containers for shipment. Florida has the highest average yield with 123 bushels per acre. North Carolina, South Carolina, and Virginia each average over 100 bushels per acre. In dry sections averages run as low as 65 bushels. The very early, off-season crop may sell in city markets for as high as $4 a bushel.

Prices to growers are more commonly \$1.50 to \$3.50 a bushel, depending upon the grade.

Varieties of the early group are Spaulding's Rose No. 4, Irish Cobbler, Bliss Triumph, and Early Ohio. Later varieties adapted to fall harvesting are Green Mountain, Lookout Mountain, Rural New Yorker, Burbank, and Money Maker.

Soils for the early crop should be rich, sandy loam with an abundance of organic matter present. Heavier soils are often used for the late crops. Green manure (Fig. 112) and well-

FIG. 112.—Cowpeas grown as a summer catch crop to produce green manure for such winter truck crops as early Irish potatoes. (State Supervisor C. L. Davis, Austin, Tex.)

rotted barnyard manure should be supplied liberally. This improves the moisture-holding power of the soil, necessary for successful growth. Plow deep and disk heavily when preparing the soil. Feed the crop with plenty of available complete fertilizer. Use a half ton or as much as one and a half tons per acre of 5-8-5 (N-P-K) fertilizer.

Planting and Culture.—Choose northern-grown seed which is sound and smooth. Treat seed as suggested in Appendix. Cut tubers into pieces weighing one to two ounces. Dust the cut tubers with ashes, or sulfur. "Green" the tubers for summer planting by exposure to moderate light for a number of days. Plant at the rate of ten to fifteen bushels per acre for good results. In warm regions plantings are made from December 1 to February 15. In cooler regions spring crops are planted in

February and March, and summer plantings are from May 1 to July 15. Both hand and machine methods are used.

Deep tillage is needed at first to keep the soil loose and open. Later, shallow cultivation is better. This should stop soon after the blossoms are open.

Dusting and spraying to control blight and beetles should be frequent enough to keep all new growth protected. This means about every two weeks after the plants are a few inches high.

Harvesting for early market is done as soon as the tubers are large enough. For home use, local sales, and for storage, tubers are not dug until vines are dead and tubers are ripe. Forks, plows, and machine diggers of several types are used. Grading may be done in the field for the early crop. Machine sizers are commonly used for the mature tubers. U. S. Department of Agriculture standards provide for five grades for potatoes: U. S. Fancy, Extra No. 1, No. 1, Commercial, and No. 2.

Bags holding 50 or 100 pounds are most frequently used for potatoes. Some are shipped in bushel baskets. Barrels, formerly widely used for this purpose, are now seldom used. Irish potatoes for winter use or for sale may be readily stored in cellars, in special storage houses, or in "pits." They must be kept cold without freezing and must not become too dry.

Selling is done coöperatively in many regions. Much of the early crop is sold direct to chain stores, wholesalers, or through jobbers. Sales by telegram are very common. Commission firms also handle some of the early crop and much of the late crop.

Irish Potato References.—U. S. Farmers' Bulletins 847, Storage; 1050, Loading; 1064, 1190, 1205, Production; 1091, Protecting in transit; 1316, 1578, Marketing; 1367, 1436, Diseases; 1462, Leafhoppers. Obtain state station publications on Irish potatoes. See *Southern Field-Crop Enterprises* in this *Series* (Lippincott); also other field-crop books. See *The Potato*, by Stuart (Lippincott).

Shop and Mechanics.—Adjust and repair planters, sprayers, diggers, and other implements and tools. Make racks for easy loading and hauling. Make or repair a grading machine. Construct a storage house or cellar.

Irish Potato Activities.—(1) Collect samples of five or more varieties and learn their characteristics. (2) Test soils by the burning-out method to determine relative amounts of organic matter present. (3) Contrast different lots of seed potatoes and judge on quality. (4) Treat and cut seed tubers for planting. (5) Contrast deep and shallow plowing for this crop. (6) Compare two rates of planting and note yields. (7) Fertilize a few rows heavier than the others and see if the results warrant the expense. (8) Cross-harrow the crop when three inches high and continue

several weeks. Contrast this with other tillage, as to expense and results. (9) Compare spraying and dusting methods of controlling insects and diseases. (10) Determine relative costs of different methods of harvesting. (11) If possible, compare two plans of selling the crop. (12) Practice machine and hand grading.

Irish Potato Calculations.—1. When potato land is valued at $95 per acre, for what should it rent to give the owner 10% on his investment?

2. A student used 1,000 pounds of commercial fertilizer per acre for his potatoes. The fertilizer analyzed 5% nitrogen, 10% phosphoric acid, and 5% potash. Find how many of each are needed for a ton, using nitrate of soda containing 15% nitrogen, superphosphate containing 16% phosphoric acid, and muriate of potash containing 50% potash.

3. Determine the cost of one pound of each of the plant food elements in the above mixture if nitrate of soda is worth $60 per ton, superphosphate $150 per ton, and muriate of potash $40 per ton.

4. Find how many pieces of cut potatoes will be needed to plant an acre if the rows are 3 feet apart and the pieces dropped 18 inches apart in the rows.

5. The labor of producing an acre of potatoes cost $65.75. What percentage of the total cost of $112.50 was the labor cost?

6. An acre of potatoes produced 160 bushels of No. 1 potatoes. If the selling price was $4.50 per barrel (11 pecks), what did the farmer receive for his crop?

7. Find the cost of marketing his potatoes if the commission merchant charged 5%.

Winter Cover Crops

Check erosion of soil
Prevent leaching of plant food
Prevent wind-blowing of soil
Produce pasture for livestock
Get nitrogen from air
Cause moisture to enter soil
Prevent cracking and baking
Produce green manure

PEACH ENTERPRISES

Collaborator: T. H. McHatton, Hort. M., Professor of Horticulture, University of Georgia, Athens, Ga.

The peach apparently originated in China. It was mentioned in Chinese literature about 2,500 years ago. From China, the peach was introduced into Persia, and the Romans were growing it over 2,000 years ago.

The Spanish colonists are credited with the introduction of the peach into the Americas at the time of the settlement of St. Augustine. Within a short period of time the seed was widely disseminated by the Indians, and the fruit was growing wild as far north as Pennsylvania and Virginia when the English settlers came to those areas. La Salle found peaches growing west of the Mississippi around the Indian villages.

Our older commercial varieties are mostly chance seedlings. Commercial peach production is a relatively young industry in the United States.

Analysis into Jobs.—The operative and managerial jobs in the peach enterprise are suggested in the following list.

Job 1. Determining Possibilities with Peaches

Conditions Usually Found.—Some peaches are grown in every state in the United States. In approximately two-thirds of the states, including all southern states, peach growing is conducted on a commercial basis.

Aims.—Growers should become acquainted with the climatic and economic factors in peach growing.

Problems for Study and Discussion

1. How many peach trees of bearing age do you have in your state?
2. How many commercial orchards are found in your community?
3. At what age does a peach orchard produce fruit?
4. What is the average number of years a peach tree will produce fruit in your locality?
5. What is the average cost per acre in your locality to bring a peach orchard to bearing age?
6. What is the average yield per acre in your community?
7. What have been the average prices per crate of peaches received during the past five years?
8. What extra labor requirement is necessary for growing peaches?

Activities.—Get peach statistics from the latest U. S. Yearbook for the past six years. Compare the past three years with the preceding three years in number of trees, production, and price.

Where Peaches are Grown.—Some peaches are grown in each state in the United States. The U. S. Department of Agriculture reports production in southern states in bushels as follows:

State	*Average 1934–1943—Bushels*	*1944 Bushels*	*1945 Bushels*
Alabama	1,463,000	1,380,000	2,440,000
Arkansas	2,061,000	2,646,000	2,967,000
Florida	82,000	121,000	114,000
Georgia	4,997,000	4,590,000	8,091,000
Louisiana	298,000	390,000	422,000
Mississippi	886,000	1,105,000	1,418,000
North Carolina	1,892,000	2,698,000	2,172,000
Oklahoma	477,000	286,000	734,000
South Carolina	2,039,000	2,460,000	5,760,000
Tennessee	1,134,000	686,000	1,862,000
Texas	1,567,000	1,519,000	2,774,000
Virginia	1,110,000	2,150,000	536,000

Georgia leads in production of peaches followed by South Carolina in recent years. Peaches do well on cotton land of the South. It is not safe to plant general commercial varieties along the Atlantic coastal plain and along the Gulf coast where the winter is mild. Trees often bloom too early in the spring in such localities and the fruit is then killed by frost. Varieties of the Honey and the Peen-to types could be used.

Available Markets.—Peaches are sold in local markets and in the markets in distant cities. Car-lot shipments of peaches are sent under refrigeration from Georgia or from California to all the principal cities in the United States. Competing areas are shown in Figure 113.

Age of Bearing Trees.—As a general rule, it takes about four years for a peach orchard to bear fruit for commercial purposes. Some fruit may be produced in the second year and more the third year; however, the owner may expect the fourth year to bring a good crop. (Fig. 114.)

The cost per acre for bringing a peach orchard to bearing depends upon several varying factors, as the rent of the land, cost of trees, amount of fertilizer used, the price of labor, and the price of spray materials. As a general rule, it should not

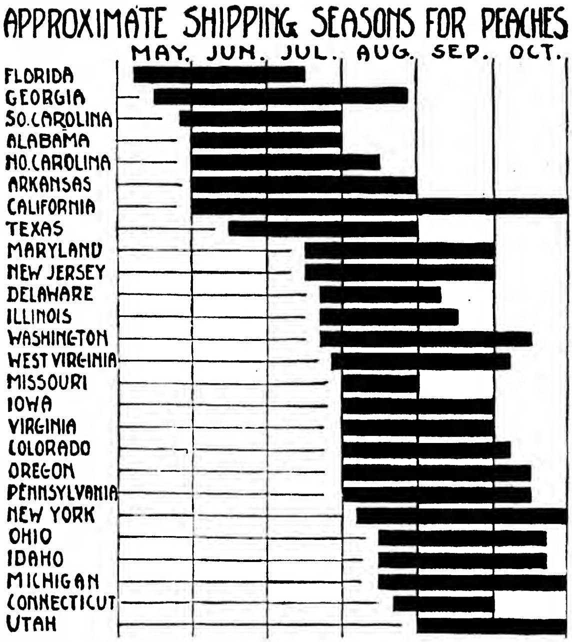


FIG. 113.—Shipping seasons for peaches from various states.

FIG. 114.—Student examining growth of one-year-old peach tree in his orchard project. The cover crop is soon to be plowed under.

cost over $200 per acre. This cost may be partly or wholly met by the growth and sale of inter-crops.

The yields per acre vary from year to year, according to the age of the trees, the season, the soil, the care, and other factors. If a grower is expecting to market in car-lot shipments, it is suggested that he plant not less than twenty acres. Good trees should produce from three to five bushels of peaches each per season.

Prices are usually good at the first of each season. It is not uncommon to receive as much a $4.00 to $5.00 per bushel. Some years, however, when the total production is high, the prices may be as low as $1.00 per bushel. Probably the average price for U. S. No. 1 would be from $1.50 to $2.50 per bushel at the loading place.

Home Orchards

Increase value of farm
Provide fruit for home
Reduce cost of living
Save health and doctor bills
Improve appearance of farm
Furnish income from surplus
Help distribute year's labor
Use land otherwise wasted
Arouse pride and contentment

Job 2. Choosing Varieties

Conditions Usually Found.—For commercial purposes most farmers plant just a few varieties. Probably the leading varieties are Uneeda, Early Rose, Carman, Hiley, Belle of Georgia, and Elberta, named in order of ripening.

Aims.—Growers should select the best varieties for commercial plantings.

Problems for Study and Discussion

1. What are the characteristics of a good commercial variety?
2. Of what importance is the color of flesh?
3. Prepare a list of varieties according to their ripening dates.
4. Which varieties most nearly meet the market demands?
5. Debate the two leading varieties.
6. Prepare a list of varieties which you would recommend for the home orchard.

Activities.—Secure several good nursery catalogs. Tabulate the characteristics of all the varieties of peaches.

Characteristics of a Commercial Variety.—There is quite a large number of different varieties of peaches grown in the

United States and each year other varieties are being introduced. Any variety chosen should be suited to the region. Some varieties may be grown over a wide area while other varieties seem suited only to limited localities.

The second important point is that the variety must be a vigorous grower and a medium or late bloomer. Especially is this point important in sections where late frosts are common.

The variety should also be productive. If a peach orchard is to be profitable, it must be of a variety which will bear a good crop of fruit from year to year.

The peach must be of a variety which is wanted in the market. Most markets prefer yellow-fleshed peaches and will pay higher prices for them than for white-fleshed peaches. Yellow peaches are also used more for canning than white varieties.

Special care must be given to the ripening dates of the variety. A variety should be selected which will ripen and be placed on the market so as not to conflict with fruit ripening in other sections. Other points to consider, so far as possible, are varieties which are disease resistant, good keepers, good shippers, attractive, and of good quality.

Early Rose.—This is used in home and commercial planting as an early cling. The fruit is of fair size and highly colored, and is a good shipper. The flesh is sweet, firm, fragrant, white. The tree is hardy, healthy, and a good bearer.

Arp Beauty.—This is much used in home orchards, and is sometimes planted in commercial orchards for early market. The fruit is of fair size, yellow skin blushed with crimson. The flesh is yellow, firm, and of good flavor. Freestone.

Mayflower.—This is a very late bloomer and a vigorous growing tree. As a rule, it lives only a short time. The Mayflower is one of the earliest varieties. It ripens from the first of May to the first of June, depending upon the season and the locality. The fruit is medium to small, white fleshed, and very juicy. When ripened in the sun it has a dark red blush on one side. The quality is rather poor, but on account of being early, profitable prices are usually received for it.

Carmen.—This variety is grown both in the home orchard and for commercial purposes. It has white flesh but the flavor is good. The fruit has a red blush, and is medium to large in size. The average season for ripening is probably about the middle of June.

Hiley makes a tree of rather spreading habits; the fruit is large, almost red, white fleshed and of good quality. This variety is a freestone and is good for commercial plantings. It ripens about the first of July.

Belle of Georgia.—This variety ripens about a week to ten days after the Hiley. The trees make a good growth and are heavy bearers. The flesh is white, freestone, and of excellent quality. It is a very good commercial variety.

The Elberta is probably the most important commercial variety. It may be grown in all sections of the United States. The tree makes a vigorous growth and is a heavy bearer. The fruit is large, yellow with a red blush, a good shipper, freestone, a good keeper, and a very good seller. It is very good for canning. It ripens near the middle of the peach season.

Hale Haven.—A cross between J. H. Hale and South Haven, this variety provides a high quality fruit ripening about 15–18 days ahead of Elberta. The fruit is of medium size, yellow flesh, freestone, and quality is excellent. It is a good shipper and a favorite on northern markets.

Other varieties, particularly for home use and for local markets, are Greensboro, Salway, J. H. Hale, Waddell, Waldo, and Sneed.

Early peaches are likely to be of small size, though the first few shipments bring good prices, and when going on the markets in large quantities they demoralize conditions for better sorts that follow later. Early fruit from Tennessee and the Carolinas competes with better fruit from Georgia and has poorer chance on the markets. It is no longer considered good business to plant heavily with early varieties. Over 51 per cent of commercial trees are Elbertas.

Good Peach Varieties

- Conform to local practices
- Suit soils and climate
- Meet market demands
- Withstand handling
- Give good appearance
- Have good quality
- Bear well and regularly
- Resist rot disease
- Blossom rather late
- Have good reputation
- Ripen by mid-season

Job 3. Selecting the Location and the Soil

Conditions Usually Found.—Sandy loams are often used for peach orchards, but the heavier loams are preferred for commercial planting.

Aims.—Growers should understand the best locations and soils for peach orchards.

Problems for Study and Discussion

1. Why locate a peach orchard on the south or east side of a lake?
2. What other factors would you consider in selecting a site for peach growing?

3. Why consider nematodes and other soil troubles before locating orchards?
4. Report on several commercial orchards regarding the suitability of their location.
5. What kind of soil is best suited for growing peaches in your community?
6. Debate: Light vs. heavy soils for commercial peach orchards.

Elevation and Slope.—It is best to locate peach orchards on a slope rather than in a valley. Elevated land affords better air drainage. The low valleys contain the cold air and more damage from frost occurs. Such conditions may be studied in early spring in commercial orchards.

Land with a southern slope probably grows peaches a little earlier than land sloping toward the north, but greater danger of frost is to be expected. It is a difficult problem to decide whether to choose a northern or southern slope for a commercial orchard from which early crops are desired.

Type of Soil to Select.—Peaches thrive on a wide variety of soils. In Georgia the Orangeburg, Cecil, and Greenville clay loams are preferred. Sandy loams are used in the Carolinas but the heavier soils are better. Trees do not live so long on light soils and they suffer more from drouth and may be infested with nematodes.

The soil selected must be well drained and moderately fertile. The subsoils of heavy texture are best, as porous subsoils lose their fertility and are subject to drouth. Well-ventilated soils tend to produce early ripening of fruit.

Distance from Shipping Point.—In selecting the location and the soil for a peach orchard, due consideration should be given to the distance from the shipping station. The peach is a very perishable crop and should not be hauled over rough roads. Where the roads are paved greater distances may be traveled without serious damage.

Soil Troubles.—Peach trees are subject to nematodes which produce galls on the roots, particularly on the smaller, feeding ones. Growth is checked and affected trees are seldom thrifty. If an orchard site has produced other crops affected with nematodes, peaches should not be grown there.

Job 4. Propagating and Buying Peach Trees

Conditions Usually Found.—Most peach growers buy their trees from some nursery. A few propagate their trees.

Aims.—Growers should understand the methods of propagation used for peaches, and know how to buy good trees.

Problems for Study and Discussion

1. From what sources are peach trees in your community secured?
2. What kind of soil is best for the peach nursery?
3. How could you obtain peach pits?
4. How are peach pits planted?
5. How is a nursery fertilized and cultivated?
6. How are peach seedlings budded?
7. How are seedlings treated after the budding is done?
8. Give the number of trees required to set an acre of orchard.
9. What sizes of trees are best for planting?
10. Debate: June-budded vs. August-budded trees for planting.
11. Describe heeling-in trees and give reasons for doing it.

Activities.—Collect materials and bud seedlings until you have developed skill in doing this job.

Securing Peach Pits.—There are three sources from which peach pits may be secured: (1) from the home orchard, (2) from canning factories, and (3) from wild seedlings found in the mountains.

Pits from the home orchard or from canning factories are not so good as the seedling pits because they do not germinate so well. The seedling pits are smaller and run a larger number per pound or bushel, and therefore require fewer bushels for planting an acre.

Planting the Peach Pits.—It is advisable to layer the peach pits in the fall. They may be packed in moist sand in layers in the early fall and kept until spring. It is best not to keep the pits in dry storage until spring as they are less likely to germinate. While in layers in moist sand and before spring, the pits should freeze and become cracked.

Rows are laid off from three to four feet apart with a bull-tongue plow and the pits taken from the sand beds are dropped approximately four or five inches apart. Planting is done in warm spring weather. Pits are covered from two to three inches. Germination should follow quickly.

Fertilizing the Nursery.—The young seedlings must be kept in a vigorous state of growth in order that they may be large enough to bud in June. A fertilizer rich in nitrogen should be

applied at the rate of about 800 to 1,000 pounds per acre. If the trees are not growing as rapidly as desired, an additional application of 100 pounds of nitrate of soda may be used.

Cultivating the Nursery.—The young seedling trees may be given thorough and clean cultivation. The seedlings are cultivated very much as are the truck or field crops, which require clean cultivation.

Budding Peach Seedlings.—In most sections of the South peach seedlings are budded in June, the pits having been planted the preceding fall. These buds should make a good growth be-

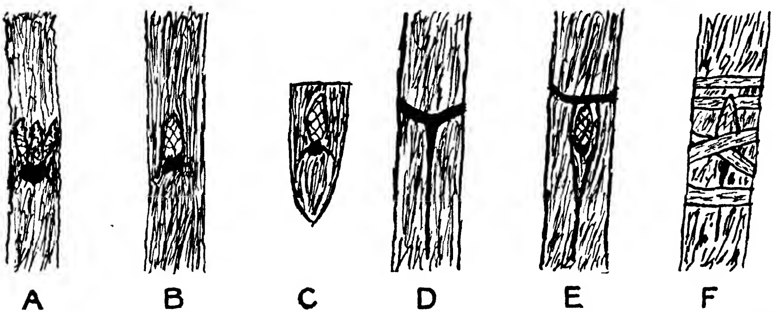


FIG. 115.—Budding Peaches. (A) fruit bud; (B) leaf bud; (C) the cut bud; (D) stock cut for the bud; (E) bud in place; (F) bud wrapped.

fore frost, and before the trees are ready to transplant to the orchard.

In preparing to bud seedlings, use a budding knife to make a vertical cut about an inch in length through the bark of the seedling just above the ground. At the top of this cut a horizontal cut across the seedling is made, forming a tee-cut for tee-budding. (Fig. 115.)

Buds are secured from twigs of a tree of the variety which is to be propagated. The leaves are removed from the twig, leaving the leaf stems attached. A bundle of such limbs are called "bud sticks." The buds are removed from the sticks with a sharp budding knife. The cut should commence about one-half an inch below the bud and cut up one-half an inch above the bud. This makes the shape of the bark and bud resemble a shield.

The lips of the vertical cut on the seedling are opened with

the point of the knife and the bud is inserted. After the bud is pushed down into position it is wrapped with either No. 18 knitting cotton, which has been previously dipped in melted grafting wax, or with moist raffia. The top of the seedling is then broken or bent down over the bud.

Each bud should be "set" in about ten days, and the wrapping may be cut on the opposite side of the stem to avoid strangling the tree. The seedling is then cut off just above the young bud as soon as it begins to grow.

It is possible to wait until August or September to do the budding. The buds remain dormant until the following spring and then begin to grow. This practice produces larger trees, but the nursery is occupied for two years instead of one. In case of August or September budding the top of the seedling stock is not cut away until the following spring.

Where to Secure Trees.—When trees are to be purchased it is best to secure them from some reliable nursery as near as possible to the orchard where they are to be used. Beside costing less in transportation when so purchased, less damage is likely to occur to the trees; however, when properly packed the trees may be shipped long distances without serious damage. The price of trees is an important factor in determining where to purchase them.

The number of trees required per acre depends upon the distance apart of the trees. If the trees are to be placed 18 by 18 feet it will take 134 trees per acre, if 18 by 20 feet it will take 121 trees, and 20 by 20 feet will take 108 trees.

Kind of Trees to Buy.—The well-rooted, June-budded trees, free from disease, are probably the best to plant. The large trees usually have to be pruned back severely to get the correct shape. Little advantage is gained by paying an extra price for them.

Heeling-In.—When the trees arrive from the nursery they should be unpacked immediately and heeled-in. They cannot all be planted in the orchard at once, and would suffer if held in the shipping boxes during the planting period. Heeling-in is done by choosing a well-drained place and digging a trench deep enough to receive the roots and then covering the roots with soil, being certain that the soil is worked among the roots sufficiently to fill all the space.

Job 5. Preparing the Soil and Setting the Trees

Conditions Usually Found.—Growers usually plow soil with a turning plow several weeks before setting the trees.

Aims.—How to prepare the soil for peaches, and how to set a tree properly should be understood.

Problems for Study and Discussion

1. How do farmers in your community prepare soil for starting a peach orchard?
2. What is the value of terracing slopes before setting trees?
3. What is the best time of year to set peach orchards?
4. What methods of laying out peach orchards are practiced in your community?
5. What are the three methods for laying out an orchard?
6. At what distances apart are the trees set in your community?
7. Debate: Close vs. open setting of trees.
8. How are the holes made for setting trees?

Activities.—Practice digging holes and setting peach trees carefully and rapidly.

Preparing the Soil for Peaches.—A good practice is to plow deep with a turning plow and harrow until the soil is thoroughly pulverized. If new soil is used, be sure to remove all of the stumps. It is best to prepare the soil several weeks before the trees are to be set.

Terracing.—Rolling or sloping sites should be terraced before the trees are set. The terraces are better if they are so constructed that spray machines and other orchard machinery may be used successfully. The trees are often set following the terraces or parallel with them. Terracing allows annual orchard tillage without serious soil erosion.

Time to Set Trees.—In all sections of the South the fall season is probably the best time to set peach trees. The trees have time to callous and put out roots by early spring. Growers usually obtain good results by setting the trees at any time from November until March. Probably most trees are set during December and January.

Laying Out Peach Orchards.—There are several successful methods used by growers in laying out peach orchards: (1) following terraces, (2) triangular or hexagonal, and (3) square. The square method is used in practically all of the orchards where the land is level or gently rolling. The triangular or hexagonal method is seldom used. The method of following terraces should be used on rolling or steep land where terraces are made for every row or two.

The square method, for all practical purposes, may be used by having the rows laid off each way similar to land for watermelons. Reasonable care should be taken to plant the trees in straight rows each way. The rows may be marked with stakes, using one stake for each tree. Sometimes a plow is used to mark the rows in one direction before the stakes are planted. This reduces the hand work in digging holes.

Distances Apart.—Trees are planted from sixteen to twenty feet apart each way. Growers now prefer to plant them not less than twenty by twenty feet. The roots of peach trees extend out farther than the limbs. Close planting requires close pruning and trees are usually headed low. Spray machinery may be crowded when the trees become large.

The holes for peach trees should be broad enough so that the roots may be spread out normally when set. Where the soil is in good condition the rows may be opened with one or two furrows of a turning plow. Using dynamite for digging holes is of little value because soil where dynamite is needed would not suit for peaches, as it becomes packed too closely.

How to Set Trees.—After the rows have been plowed as suggested in the preceding paragraph, the soil is removed for each tree by means of a shovel. On land level enough to mark it off with a plow, furrows are opened with a turning plow and a subsoil plow. In good soil these furrows are deep enough for small trees with little digging. After a number of holes are dug, usually two men work together in setting the trees. One man holds the tree in place, arranges the roots in their natural position, and tramps the soil shoveled in by the second man. In shoveling in the dirt, the top soil is used first. When the furrow method of planting is used, stakes are set for the first trees of each row. Then with a pole of the desired length the trees are rapidly set at proper distances. Cross marks are sometimes run in advance. This avoids the handling of a pole. Trees may be rapidly set by covering the roots a little and later using a plow to turn more soil to the trees. Tramping and pruning follow this. If the weather is dry, a half bucket of water should be used to each tree and the place covered with dry soil.

Low Heading.—Growers usually desire low-headed trees, so that fruit may be harvested without the use of ladders. The practice is to head the trees back to 18 inches. The most rapid

method of doing this is to run over the orchard after the trees are set and cut the switches at a uniform height. Allow about four well-spaced branches to grow the next spring. All of the other branches which come out are rubbed off as rapidly as they appear.

Job 6. Providing Plant Food; Fertilizing

Conditions Usually Found.—Peaches in home orchards are seldom fertilized. Commercial growers generally use fertilizers, and plow under green manure crops.

Aims.—Growers should be able to decide on the best fertilizers for peaches. They should be able to grow and use green manure crops.

Problems for Study and Discussion

1. What are the necessary elements required for plant growth?
2. Which of these elements need to be added as fertilizers?
3. What are the effects of each fertilizer element?
4. What do we mean by a 4-10-4 fertilizer?
5. Calculate the respective weights in a ton of a 4-10-4 fertilizer using nitrate of soda (18%), superphosphate (16%), and muriate of potash (50%).
6. What kind of fertilizer is best for peaches in your community?
7. What are some of the advantages of home-mixing fertilizers?
8. How is fertilizer put around each tree?
9. At what time of the year would you apply fertilizers?
10. Give the value of a green manure crop in a peach orchard.
11. How much fertilizer is used per acre for bearing peach trees?

Kinds of Fertilizer.—Peaches require a liberal amount of plant food. If a good green manure crop is turned under each year, less nitrogen will be needed in the commercial fertilizer. The exact amount of fertilizer to use depends upon several factors, such as the age of the trees, the kind and fertility of the soil, and the kind of fertilizers being applied.

In many places growers use from three to ten pounds of a 4-8-4 (N-P-K) fertilizer per tree. Young trees need from three to four pounds of such a fertilizer per tree, while a bearing orchard may profitably use eight to ten pounds per tree.

Time to Apply the Fertilizer.—Fruit buds for peaches are produced the preceding season, and plant food applied in June or earlier will aid in their development. Georgia experiments show that peach buds start to differentiate into fruit and shoot buds in June for the next season. In most cases the fertilizer is applied in the early spring three weeks before blossoming time. Then nitrate of soda is used two weeks after blossoming. If frost kills the crop, less fertilizer will be needed.

Methods of Applying.—The fertilizer is usually scattered around the tree in a circle. For young trees the fertilizer should be applied in circles about two feet from the trees. For bearing trees the fertilizer is applied a little farther from the trunks than the spread of the branches. For old orchards the fertilizer may be applied between the trees in any manner because the

FIG. 116.—Young man studying growth and examining blossoms in his two-year-old peach project in York Co., South Carolina. (N. W. Williams.)

roots will be farther out from the trees than the branches. The fertilizer is worked into the soil with a cultivator or harrow.

Green Manure.—Especially while the orchard is young, it is desirable to grow a cover crop each winter to turn under as green manure for soil improvement. (Fig. 116.) It is possible to use Austrian peas, winter vetch, and rye as a mixture for this purpose. If cowpeas are used as a summer crop, be certain to plant only the Brabham or the Iron variety, as other varieties may aid in the development and spread of nematodes.

Job 7. Cultivating the Peach Orchard; Growing Intercrops

Conditions Usually Found.—Orchard cultivation is often neglected or is done in such a manner as to injure the trees; intercrops for young orchards are often not grown.

Aims.—Growers should understand the reasons for intercrops and for cultivation, and should know proper methods to follow.

Problems for Study and Discussion

1. What is the value of cultivation?
2. What implements are used in your community for cultivating the peach orchard?
3. When would you begin to cultivate a peach orchard?
4. What crops are best for growing between rows in a young peach orchard?
5. Give arguments for and against intercropping young orchards.
6. How many cultivations are given peach orchards per year?
7. How are bearing orchards cultivated?
8. How are trees on a hillside cultivated?

The Value of Cultivation.—Cultivation is for several purposes: (1) It improves the physical condition of the soil. (2) It should conserve moisture by forming a soil mulch and increasing the water-holding capacity of the soil. (3) It controls weeds, thus saving plant food and moisture for the trees. (4) It airs and warms the soil in early spring. (5) It helps to destroy insects which infest the soil. (6) It turns under green manure. (7) It prepares soil for the winter cover crop.

Intercropping Young Orchards.—There are several reasons for growing money crops between the rows of young trees: (1) It defrays orchard expenses until fruit begins to pay. (2) It causes the grower to cultivate the trees while caring for the intercrops. (3) It likewise encourages fertilizing of young trees. (4) The grower will give more care and attention to trees than if they are grown alone. (Fig. 117.)

Crops for the Peach Orchard.—During the first few years it is possible to produce some low-growing crops in the peach orchard. In many places cotton is grown between the rows, but calcium arsenate used on cotton will injure fruit trees by causing the leaves to drop. Quick-maturing truck crops such as melons or beans should be valuable for this purpose. Avoid tall crops such as corn, unless plenty of space is left for the trees. Avoid tomatoes, strawberries, or other crops which might introduce nematodes or other soil troubles which attack peach trees. After the orchard is four years old it is probably best

to discontinue the growing of any crops in the peach orchard, except winter cover crops.

Implements and Cultivation.—The turning plow is best for turning under the winter cover crop as green manure in the spring. Double-disk harrows with the extension beams are used by many growers for cultivating during the growing season when there is no intercrop. If the soil is cultivated frequently, a spring-tooth harrow or a spike-tooth harrow may be used. Summer tillage should cease sufficiently early to allow the trees

Fig. 117.—Cultivation between rows both ways gives good results. This is possible if the slopes are not steep and not terraced. Scene in the Carolinas. (Seaboard A. L. Ry.)

to harden for winter. The winter cover crop is sown during August or September.

Job 8. Pruning Peach Trees

Conditions Usually Found.—Few farmers properly prune their home orchards, but commercial growers usually prune according to good methods every year.

Aims.—Growers should know the value of pruning, and should develop ability or skill in pruning peach trees rapidly and well.

Problems for Study and Discussion

1. What is the fruiting habit of the peach tree?
2. Why should growers prune peach trees?
3. What pruning tools are used?
4. At what time of the year should you prune peach trees?
5. Describe the shape you want in peach trees.
6. How are young trees pruned when they are set in the orchard?
7. Debate: Low heading vs. high heading for peach orchards.

8. How do growers thin the fruit?
9. How would you dispose of limbs and twigs after pruning?

Activities.—Observe pruning methods in the best orchards. Practice pruning peach trees properly to acquire skill and speed. Sharpen and repair pruning tools in the shop.

Reasons for Pruning.—Peach growers usually believe in pruning their orchards each year. The main reasons for pruning are as follows:

1. To give the tree the correct shape.
2. To open up the top so as to admit sunlight.
3. To make the tree grow more stocky.
4. To remove dead or diseased limbs.
5. To stimulate new growth and thereby get more fruiting branches.
6. To thin the fruit.
7. To make spraying and cultivating easier.
8. To aid in harvesting the fruit.

Fruiting Habits of the Peach.—The fruit buds of the peach are borne on the youngest twigs and bloom the following spring. For this reason, if a tree does not make normal growth during the summer little fruit is to be expected the next year. The fruit buds are borne beside the leaf buds and may be borne in pairs, in threes, or singly.

Pruning Equipment.—There is a great variety of pruning tools on the market. The one tool used most frequently is the hand shears. If the pruning is kept up properly these shears serve all purposes for cutting the average limbs. To remove large limbs a pair of heavy lopping shears will be needed. In some cases, a pruning saw may be used for large limbs instead of the lopping shears. A long-handled pole pruner, which is necessary for apples, will seldom be needed in a peach orchard unless the trees are old or high. Such a pruner aids in cutting back the long new growth in high trees. Since few tools are needed for pruning the peach orchard, it is suggested that nothing but good ones be purchased.

Low vs. High Heading.—Pruning newly set trees was described in Job 5. When trees are headed low fruit is easier to pick, and spraying and pruning may be more thoroughly and rapidly done. When trees are headed on high trunks cultivation is easier, and sunlight may reach the fruit better.

Pruning Young Trees.—If all extra branches are kept off the first season after planting, the three or four branches left should

grow three or four feet by the end of the season. These main branches should be cut back about two-thirds of their length after they become dormant.

The correct vase-shaped top is formed by cutting off these main branches each time just above a side limb or just above an outside leaf bud. The head should be kept thinned to avoid crowding of limbs. Cross limbs should be removed. (Fig. 118.)

Pruning Bearing Trees.—After the trees come into bearing, severe pruning is seldom needed. By this time the form of the tree should be established. (Fig. 119.) The center of the tree

FIG. 118.—Peach tree before and after pruning. Project of Frank Bachmayer, Taylor, Tex.; W. N. Elam, teacher. (C. L. Davis, State Supervisor.)

should be kept open to admit the sunlight; and a part of the preceding year's growth should be removed each winter by heading back. All diseased or broken limbs should be removed.

Thinning the Fruit.—Few commercial growers practice thinning peaches except as a part of the pruning. Hand picking of the young fruit is expensive and cannot be done until natural dropping of fruit is over. In the late spring, after the May drop of peaches, the small fruit may be thinned out so that the peaches are left three to four inches apart, depending upon the variety. (Fig. 120.) The labor required for thinning is very much reduced if the trees are properly pruned in the winter.

Job 9. Controlling Insects and Diseases

Conditions Usually Found.—Growers find it necessary to fight several different insects and diseases.

Fig. 119.—A low-headed peach tree pruned to form an open center. Orchard yield one bushel per tree, selling at $3.00. Richland Co., S. C.

Fig. 120.—Peaches crowded on tree. They grow larger and rot less if thinned when less than an inch in diameter. (Seaboard A. L. Ry.)

Aims.—Growers should know how to identify each peach insect and disease and how to control each of them.

Problems for Study and Discussion

1. Describe the injury of peach-tree borers.
2. Give the life history of this insect.
3. Report what growers control this enemy by chemicals and how many use other methods.
4. Give directions for using para-di-chloro-benzene for the control of peach tree borers.
5. Describe the damage due to San José scale.
6. What spray would you use for the control of San José scale? When used?
7. Give directions for making oil emulsion. For making lime-sulfur.
8. What causes the worms that are usually found in peaches?
9. Describe the curculio in the larva and adult stages.
10. During what conditions of blossoming and fruiting do the curculio beetles lay their eggs?
11. How may the curculio insect be controlled?
12. Describe the injury done by the oriental peach moth.
13. How may the oriental peach moth be controlled?
14. How do nematodes injure peach trees? What is crown gall?
15. In what way may nematodes be controlled?
16. Describe the brown rot disease of peaches. Give cause.
17. In what form does this disease live over from one season to another?
18. How is brown rot controlled?
19. Describe the injury done by peach scab.
20. What are the best control measures for this disease?
21. How does leaf curl injure peach trees?
22. How may leaf curl be controlled?
23. Describe the damage from shot-hole disease (Bacterium pruni). Give control.
24. Talk with growers regarding effects of bacterial spot and bacteriosis, and suggest control.
25. Which is better, the liquid lime-sulfur or the dust form?
26. When may arsenate of lead be combined with a lime-sulfur spray?
27. What is the best spray equipment for your peach orchard?
28. Prepare a spray schedule in chart form for peaches, including both insect and disease enemies.

Activities.—Collect specimens of insects and diseases and examples of injury. Preserve these in 5 per cent formalin in glass containers.

Peach-Tree Borers.—The larvæ of peach-tree borers may be found under the bark of trees and just beneath the surface of the ground. The insects pass the winter in the larva stage and pupate in the late spring. The adults are about the size of a wasp. The female is dark blue with opaque forewings and a yellow or orange band around the abdomen. The male has clear wings and several small orange bands around the abdomen.

Soon after the adult females come out of the pupa stage they begin laying eggs on the trunks of trees near the surface of the

ground. As the young borers hatch they work into the trunk of the tree.

In practice, growers use two methods of controlling peach-tree borers. For young trees, the most practical method is to mound up the soil to a height of six or eight inches around the trees just before the adult females begin to lay eggs. The females will then deposit eggs above the mounds. About December first these mounds are torn down and the young borers are dug out with a knife. Spray mounds when trees are sprayed.

For trees more than two years old, growers have found the practice of fumigating the soil with para-di-chloro-benzene very satisfactory. This chemical when placed on the soil evaporates slowly, forming a gas which is heavier than air. All weeds and grass are removed from around the base of the tree. The chemical is then applied in a ring around the trunk of each tree. This ring should be about two inches wide and about two inches from the trunk. (Fig. 121.) Use 1 oz. for mature trees; ¾ oz. for trees four years old; and ½ oz. for trees two or three years old. The material is then covered with several shovelfuls of soil and tamped down. As the gas is formed it goes down to the roots and trunk of the tree and kills the larvæ. The best time for this treatment is about October 10, and the soil should not be colder than 60 degrees F. Scatter the mound of soil in about six weeks. (See Appendix.)

FIG. 121.—Treating peach trees in fall for borers, with para-di-chloro-benzene. Project of John Gartrel, Horn Lake, Miss. (F. C. Graham, Agr'l Teacher.)

The San José Scale.—The adult scales are round and appear smaller than pin heads. They are grayish in color and give the older branches a scaly appearance. They are found on the twigs, leaves, fruit, and branches of trees, and feed by sucking the sap. When the scales are mashed with a knife blade a greasy effect is noticed. The scales multiply very rapidly during the summer. The young scales crawl about until they find a place to feed and never move afterward. The young scales are yellow in color,

and have soft bodies, but when they attach themselves to their feeding places they begin to develop crusty gray scales.

The San José scale is hard to kill with any ordinary spray material which can be used in the summer. The only method of control is to spray the trees in the winter. Use either a solution of winter-strength lime-sulfur or lubricating oil emulsion. These sprays may be prepared according to directions found in the Appendix. When scale is serious, use oil emulsion about December, and lime-sulfur in February.

The Plum Curculio.—The adult of the plum curculio passes the winter as a beetle under trash or in other protected places. It is a small brown or grayish snout beetle with a hump on the back. In the early spring these beetles come out about the time the peach buds begin to swell. Some keep coming out for several weeks. The adults feed on the young growth and later puncture the skin of the young fruit and lay eggs near the wounds. These eggs hatch in three to five days and the young larvæ or "worms" bore their way into the fruit. Many of the young fruits with larvæ may fall to the ground, and the larvæ develop to the pupal stage in sixteen to eighteen days from the time of hatching. The pupal stage is passed in the soil, requiring not more than two weeks.

This insect does considerable damage to the peach crop every year. Growers find that it may be held in check by certain sanitary measures, such as cleaning up all rubbish, frequent cultivations in the spring to destroy the pupæ, and picking up small fruits as they fall in the spring; but these sanitary measures must be supplemented by thorough spraying of trees.

The late winter spray for scales may include poison to kill early beetles feeding on the bursting buds. When buds first show pink is a better time for this first poison spraying. After blossoming, when calyx rings are shedding, poison should be included in the lime-sulfur spray. This should be repeated at intervals of about two weeks. Experimental work in Georgia indicates the need of fighting a late brood of curculio by dusting with arsenate of lead before Elbertas ripen, and perhaps again after late varieties are all harvested.

The Oriental Peach Moth.—The adult of this insect is a brownish moth. The moth lays her eggs on the under side of the leaves. As the larvæ hatch they bore into the tips of the twigs

and kill them. The larvæ also bore into the fruit during the ripening period.

Very little is known about good control measures for these insects. Some growers practice spraying the trees with nicotine sulfate at the rate of three-fourths of a pint to fifty gallons of water, or add it to the regular curculio spray. Some have had fair results by pruning out infected twigs as soon as noticed. This is rather expensive.

Root nematodes are very small worms which live in the soil and attack the roots of peach trees and many other plants, causing large galls or knots to be formed. Trees become dwarfed and unprofitable. Sandy soils seem to favor the growth of nematodes. Be certain to select a peach soil which has a clay subsoil. Avoid planting orchards on soils which are known to be infested with nematodes. If other crops showing nematode galls have been grown on this site, the orchardist must take warning. No practical method is known for freeing a field of nematodes.

There are several seedling varieties of peaches which seem to be more resistant to nematodes than others. These seedling varieties are being used for stocks and may prove to be valuable. Peaches on plum stocks are more resistant to nematodes but the tree growth is less vigorous and plum stocks are not commercially used.

Root Gall.—This disease is caused by bacteria which form tumor-like knots on the roots. The effects are similar to the attacks of nematodes. The disease spreads in the soil. No control measure has been found except to prevent it from entering the orchard. Examine nursery trees carefully and be certain to select trees which are free from this disease.

Brown Rot.—This disease is found in practically every peach orchard. It is caused by a fungus which lives over winter on old diseased fruit called "mummies," or on the limbs of trees. In the spring the disease begins to spread and attacks the young fruits and twigs. The fruits rot and heavy losses are common. The method of control is to spray with one of the wettable sulfur spray compounds, as given later in the spraying schedule for peaches. Dead twigs and mummified fruits should be removed each winter.

Peach Scab.—The fungus of this disease attacks the twigs and the young fruit. The disease lives over the winter just under

the bark of the twigs. In the spring the fungus begins to develop and spores are spread to the young fruit. The scab produces black specks on the fruit and large splits or cracks develop. The disease is controlled by spraying with one of the many wettable sulfur spray compounds, as given in the spray schedule.

Peach Leaf Curl.—This disease is caused by a fungus which attacks the young leaves in the spring as they begin to develop. The leaves turn yellow and become thick on the sides and curl, later falling to the ground.

The concentrated lime-sulfur spray recommended for the control of the San José scale should help to control this disease. Bordeaux made from 2 lbs. of copper sulphate, 1½ lbs. lime in 50 gallons of spray is an effective control for leaf curl, and can be used alone or with the dormant oil if scale is present.

Spray Schedule for Peaches

When	*Materials to Make 50 Gallons*	*What for*
When trees are dormant but where temperature is above 40 degrees	6 gallons liquid lime sulfur or one of the dormant oil sprays, at concentration recommended by the manufacturer, in bordeaux made from 2 lbs. copper sulphate and 1½ lbs. lime	San José scale and peach leaf cure
Where 75 per cent of petals fall	2 lbs. of wettable sulfur	Brown rot
When shucks are splitting from the fruits	2 lbs. of wettable sulfur 1 lb. lead arsenate 1 lb. zinc sulfate 2 lbs. lime	Brown rot Curculio
About 2 weeks after shuck-fall spray	Use same materials as used in previous spray	Brown rot Scab Curculio
Three weeks before ripening	2 lbs. wettable sulfur	Brown rot
One week before ripening	2 lbs. wettable sulfur	Brown rot

If brown rot should appear earlier than three weeks before the fruit begins to ripen, spray immediately, using 2 lbs. wettable sulfur and repeat at weekly intervals during rainy periods.

Bacterial spot or bacteriosis was known under the old name of shot-hole fungus. It is caused by *Bacterium pruni,* and first appears as water-soaked areas on leaves, twigs, and fruit of peaches and plums; these spots become gray and then darker and sunken. Shot holes and ragged areas may show on leaves. The disease is often serious in eastern and southern states. Malnutrition makes varieties more susceptible, and the disease may be kept in check in southern orchards by proper pruning, cultivation, and fertilization. Use nitrate of soda to nourish trees. Recent experimental work suggests possible good results by spraying with zinc-lime at two-week intervals beginning at petal-fall; using four pounds zinc sulfate crystals, four pounds good hydrated lime in fifty gallons of water, kept well agitated. (See U. S. Dept. Agr. Bul. 543.)

FIG. 122.—Vocational student, Horn Lake, Miss., spraying against curculio insects and brown rot disease, using poisoned lime-sulfur. (D. L. Williams, State Supervisor.)

Spray Equipment.—The knapsack sprayer is of little value in a peach orchard. For a small orchard a barrel spray outfit is satisfactory (Fig. 122), but where there is an orchard of more than five or ten acres it is best to use a power outfit. It is very important to clean all of the spray equipment after using it. Spray materials will soon injure both the pump and the hose if allowed to stand without careful cleaning. Be certain to drain all parts after spraying to prevent corrosion and bursting in freezing weather.

Use strong hose and connections that will stand heavy pressure of 100 to 200 pounds. Use nozzles of the disk type which produce fine mists of spray. Rods should be ample in length and should have an angle at the end to aid in spraying under the leaves and twigs. (Fig. 122.) (See formulas for spray materials in Appendix.)

Job 10. Harvesting, Grading, and Packing

Conditions Usually Found.—Peaches are picked by hand and brought to the packing shed for grading and packing Careless methods are too often practiced.

Aims.—Students should know when to pick peaches and should develop skill in picking them; they should know how to grade and pack peaches according to the best standard practices.

Problems for Study and Discussion

1. At what stage of ripeness would you pick peaches for shipping? For the home market?
2. What containers are used in picking peaches?
3. How many pickers are needed to pick an orchard of average size in three days?
4. What kind of labor is being used for picking peaches in your community? In other communities?
5. How are the peaches hauled from the orchard to the packing house?
6. What is the best type of packing house in your community?
7. By what methods are peaches graded?
8. What kind of packages are most commonly used in packing peaches for shipment?
9. What are the advantages of each kind of container being used?
10. How are peaches packed in the crate?
11. What standard packs are used?

Activities.—Participate in the picking, grading, and packing of peaches. Make picking ladders of the tripod or step-ladder type.

Time to Pick Peaches.—For the local market, peaches are left on the trees until they are ripe. They are usually picked the day before being carried to market. The quality is generally better than peaches picked for shipping. All fruit to be shipped to distant markets must be picked while the fruit is still firm. The peaches should be full grown and well colored but they should not be allowed to become soft. A picker should soon learn at what stage of ripeness to pick them.

As a general rule, peach orchards are picked over every two or three days. From three to five pickings are necessary, depending upon the seasons and upon the variety.

Method of Picking.—Peaches are picked by hand, and any unskilled labor may be used. Care should be taken to pick the fruit at the proper stage of ripeness. As the fruit is picked, it is usually placed in baskets holding five-eighths of a bushel. These baskets are hauled to the packing house without being poured into any other containers. Double-decked wagons are useful in hauling these baskets from the orchard to the packing house.

Packing houses are usually made two stories high. The first floor is used for packing the fruit and the second floor for storing crates and supplies. The sides of the packing house are left open on the first floor, to admit air. The storeroom may be in

under the roof like an attic. The packing room may be made high enough for driving in with a wagon or truck.

The size of the packing house depends upon the amount of fruit to be packed. Probably less space is needed for packing

FIG. 123.—A large percentage of fruit is perfect if thoroughly sprayed. In this case about 10 per cent show some defects. (S. C. Exp. Sta.)

peaches in bushel baskets than in crates. As a general rule, packing houses are made twice as long as wide. A house sixty feet by thirty feet would be large enough to take care of fruit from fifty to seventy-five acres.

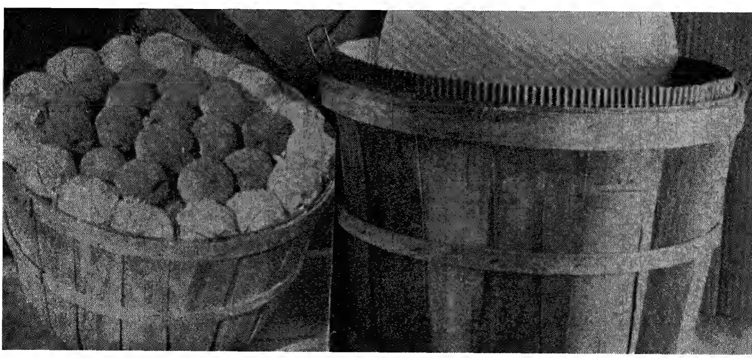


FIG. 124.—The straight-sided bushel basket and the round-bottom form are both used in shipping peaches. (U. S. Bu. Agr. Econ.)

Grading Peaches.—In most large commercial orchards machine sizers are used for sizing peaches. Fruit that is damaged or over-ripe or diseased is separated by hand as it passes over the machine (Fig. 123). Fruits should be sized by hand where

machines are not used. The grades usually given are U. S. Fancy, U. S. No. 1, U. S. No. 2, and Unclassified.

Containers.—For shipping to the market, mid-season and late varieties of peaches are usually packed in round-bottom or flat-bottom bushel baskets (Fig. 124). The early fruit is usually shipped in one-half bushel baskets (Fig. 125). The latter show the fruit to better advantage and carry it better in shipment. Hamper baskets were formerly much used but are less common now.

Method of Packing Peaches.—Where bushel baskets are used they are filled almost to the top with fruit without any

FIG. 125.—A farmer loading peaches from a packing shed near Leesburg, Virginia. (U.S.D.A. Photograph.)

special attention being paid to the pack. The top is then "faced" with fruit arranged in a very attractive form. Usually the circular rings are quickly made through the use of a grooved metal top and a paper form.

Packing forms also are available for use in the packing of one-half bushel baskets. The early varieties are softer, thus more easily bruised than the later maturing fruits and are smaller in size. They will arrive on the market in better condition and make a better appearance if packed in the smaller containers. A few six-basket crates are used.

Wrapping.—For extra fancy fruits wrapping with tissue paper is sometimes practiced. This is most important when long shipments are necessary. Wrapped peaches cannot be shipped under refrigeration during heat of summer, unless the peaches

are pre-cooled before wrapping. Sweating in transit ruins them. Costs of pre-cooling products or cars may be greatly reduced by using the electric fan system in connection with ice.

Job 11. Marketing the Peach Crop

Conditions Usually Found.—Much of the peach crop is consigned to commission merchants. Coöperative organizations are becoming more common.

Aims.—Growers should understand the different methods of marketing and should know how to load cars for shipping.

Problems for Study and Discussion

1. How are peaches loaded at the loading station in your community?
2. Report opinions of growers regarding methods of marketing being used.
3. What method of marketing would you use?
4. What advantages do you see in the different methods of marketing?
5. Under what conditions would you send peaches by express?
6. How many crates or baskets are required to load a refrigerator car?
7. How often are the refrigerator cars re-iced in transit?

Activities.—(1) Participate in loading and icing cars. (2) Fill out bills of lading. (3) Get a set of rules of a marketing association. (4) Make crates from stock material.

Loading Cars for Shipping.—Most of the peach crop is shipped to market in refrigerator cars. These cars are so constructed that low temperatures may be maintained during transit. The different railroad companies maintain icing stations enroute so that the cars may be re-iced as often as necessary. Pre-cooling and re-cooling methods are sometimes substituted for icing if the distances are not too great.

The standard size of refrigerator cars is 8 feet 4 inches wide and 33 feet long.

The crates are loaded side by side across the car. Seven crates placed with a two-inch air space between crates make a row. Sixteen crates are placed lengthwise of the car, making 112 crates for the first layer on the floor of the car. The crates are placed four layers deep, which makes 448 crates to the standard car.

As the crates are placed in the car they are nailed in place with strips of wood. The usual strip used is 8 feet long, 1 inch thick, and 1¼ inches wide. The strips are nailed across the tops of the crates to prevent the weight of any layer from mashing the fruit in the layer below it, and to insure ventilation.

The bushel baskets are held together in the car by placing the ends of the cross-arms on the top into the handle of the next basket. The baskets are usually placed three deep. A car holds from 365 to 387 bushel baskets, depending upon the exact size of the refrigerator car.

Methods of Marketing.—There are several methods of marketing used by peach growers: (1) consigning the fruit to commission merchants; (2) selling the fruit for cash f.o.b.; (3) selling in the spring for future delivery; (4) selling on trees, purchaser to pick and pack; (5) selling delivered to the packing house; (6) selling through a coöperative marketing association.

Consigning Fruit.—Most of the crop in some sections is consigned to commission men. These men sell the peaches and charge about 10 per cent for their services. Unfair treatment in some cases may be practiced; but the main trouble is that too many shippers may ship to the same market, and glut the market.

Cash Sales.—In selling peaches for cash on the tracks a grower is certain of a specified price. The price offered, however, is usually low enough for the buyer to make a safe profit. The buyer assumes all risks after the time of purchase.

Contracting the Crop.—The only advantage of selling the crop for future delivery is that the grower knows what he is to get for his crop and can plan his business to that end. If the prices become higher he must take the contract price. In some cases the contract price may be higher than the market price on delivery.

Coöperative Marketing.—If all of the peach growers in the South were to form a coöperative marketing association much good could be accomplished. Each market could then be supplied with fruit as it is needed and fruit could be standardized better. The individual farmers would then receive more money for their crops because only the actual cost of marketing would be charged.

Marketing associations aid members in several other ways: buying baskets cheaper, financing production, securing fertilizers and spray materials at wholesale prices, and distributing pickers at harvest time.

Job 12. Keeping Records

Special Records.—Orchardists should keep records to show the times and methods used in fighting insects and diseases; the results of control work; yields of trees under different treatments; returns from different varieties; and the results of different methods of marketing. The record forms used for other enterprises should also be obtained and used. See the Melon Enterprise.

Station publications are frequently changing. New bulletins often replace older ones. Students should obtain the latest peach bulletins from each state interested in commercial peach growing.

Peach Calculations.—1. Find from the U. S. Yearbook of Agriculture what percentage of the total peach crop is produced in your state.

2. If peach trees are set 20 by 20 feet, how many will be needed per acre for the square method?

3. For the hexagonal method, how many more can be set per acre if 20 feet apart?

4. A student desires to set 1,000 trees, using the hexagonal method. The trees are to be set 18 feet apart. How many acres of land will he need?

5. How many peach trees are needed to supply a car-lot shipment if 448 crates of the six-basket type are used and each tree yields 3 crates?

6. If the peaches in problem 5 are packed by the 2-2-10 method, how many are packed per crate?

7. If the net amount received from a commission merchant for a car of peaches was $1120, what would a grower receive who had 35 crates in the car of 448 crates?

Roadside Markets

Let motorists deliver products
Bring cash returns daily
Use women and children
Teach business selling
Demand quick service
Require well-graded products
Need 500-foot warning signs
Succeed in good locations
Use right side toward city

Success in Roadside Selling

Build neat shelter
Provide parking space
Keep space orderly
Offer large variety
Show prices clearly
Cut below city prices
Offer best products—no culls
Pack to suit customers
Appeal to city people

APPLE AND PEAR ENTERPRISES

Collaborator: M. E. Gardner, B.S., Pomologist, State College, Raleig' . N. C.

The place of origin of the cultivated apple is believed to be the Caucasus Mountains, in the region between the Black and Caspian Seas. Diverse forms of the wild apple are to be found in that and adjoining regions today. Apple seeds were brought to America by the early settlers. Most of the important varieties grown today in the United States are chance seedlings, or their sports. The development of new varieties, however, has been an important project at several of the experiment stations, particularly New York, Iowa, Minnesota, and South Dakota. A number of new varieties have been introduced as the result of the work at these stations. A number of years of test must follow the introduction of new varieties to determine their true worth under varying conditions. One of the greatest contributions within recent years has been the recognition and propagation of the color sports of some of the older varieties. Notable among these are the "double red" sports of Delicious, Rome Beauty, Stayman, York, and McIntosh.

Analysis into Jobs.—The following are the main teaching units or operative and managerial farm jobs in an apple or pear enterprise.

Job 1. Determining Possibilities with Apples and Pears

Conditions Usually Found.—Many people plant apple and pear orchards and then fail to care for them.

Aims.—The students should understand the requirements for success with these enterprises and consider all factors to determine for themselves whether or not to plant an orchard.

Problems for Study and Discussion

1. Where are apples and pears grown on a commercial basis in the South?
2. What is the acreage for each fruit in your community?
3. What does it cost to produce an orchard to bearing age?
4. How long must capital be invested before returns are received?
5. Find common yields per acre for each fruit.

6. What have been the average prices received by growers for apples and for pears during the last five years?
7. Where do you have markets for your fruit?
8. What are the problems which you would have in succeeding with these fruits?
9. In what jobs will the heavy labor peaks occur?
10. What other enterprises do not seriously interfere with apples and pears?

Activities.—List the equipment needed for this enterprise. Make as much as possible of this in the shop. (Fig. 126.)

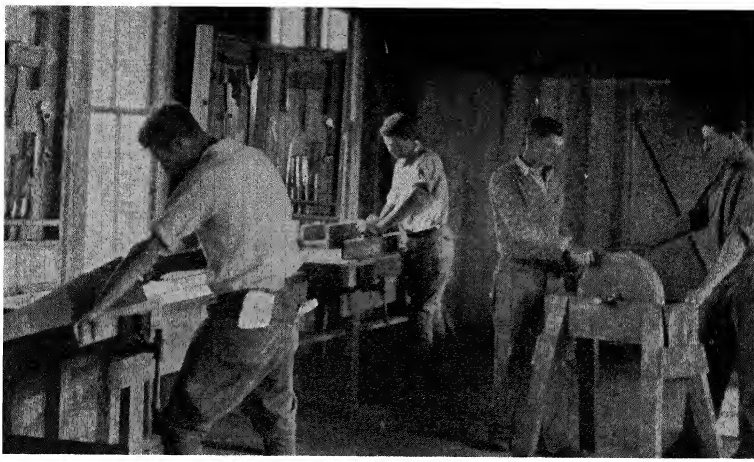


FIG. 126.—Horticultural shop work may include the making of things for student projects, and repair of tools and equipment.

Where Apples are Grown in the South.—Apples may be grown in home orchards in any state in the South; however, for commercial purposes they are limited chiefly to the mountainous sections. Since 1939, U. S. D. A. estimates of the apple production have been limited to the so-called "commercial" states which include only four of the southern states. These four states with average production in bushels for the 10-year period, 1934-43, are as follows: Virginia 10,903,000; North Carolina 1,078,000; Arkansas 753,000; and Tennessee 304,000 bushels. There are in the other southern states, except Louisiana and Florida, apple orchards from which a considerable quantity of apples are sold, but the major production is found in farm orchards.

While the commercial production is primarily for sale through

the fresh market channels, in Virginia about 40 per cent were sold to processors from the 1942, 1943, and 1944 crops.

Pear Production in the South.—Pears are grown over a wider territory than apples. There are few large commercial centers for producing pears in the South. The commercial centers of America are located in California, Oregon, New York, Michigan, New Jersey, Delaware, and Maryland. There are a few orchards in all of the states which produce fruit for local markets and for home use. The average southern production of pears in bushels for 1934-1943 inclusive is as follows:

Texas	403,000	Tennessee	286,000
Mississippi	360,000	Arkansas	172,000
Virginia	349,000	Louisiana	163,000
Georgia	347,000	Oklahoma	143,000
North Carolina	317,000	Florida	136,000
Alabama	291,000	South Carolina	128,000

Cost of Orchards.—From five to ten years of growth are needed for orchards to reach profitable bearing, and this is longer for apples than for pears. The orchard should be profitable for twenty-five to thirty-five years if properly managed. The totals vary from $250 to $500 per acre to bring the orchard to profitable bearing condition.

Yields per acre or per tree vary with the season, the variety, the fertility of soil, and the size and age of trees. A grower may get from one to fifty bushels of fruit per tree. State averages often show three to five bushels per tree of bearing age.

Prices and Production.—The market prices for apples and pears vary from year to year. Season average prices per bushel received by growers in selected years are as follows:

	Apples			*Pears*		
State	*1940*	*1942*	*1944*	*1940*	*1942*	*1944*
Virginia	$ .73	$1.13	$1.95	$ .55	$ .75	$1.25
North Carolina	.75	1.02	1.65	.80	.90	1.85
South Carolina				.65	.80	1.60
Georgia	.84			.50	.65	1.15
Florida				.50	.60	1.10
Tennessee	.88	1.21	2.70	.80	.90	1.80
Alabama				.65	.75	1.45
Mississippi				.47	.65	1.45
Arkansas	.75	1.21	2.35	.70	.95	1.70
Louisiana				.50	.65	1.45
Oklahoma				.75	.85	2.00
Texas				.60	.85	1.80

Job 2. Choosing Varieties

Conditions Usually Found.—Care has to be taken to select varieties which are adapted to the locality. Growers have learned also to select varieties which are demanded by the market.

Aims.—The student should be able to select the proper varieties to grow in his community, considering markets, uses, disease resistance, soil, bearing, duration of trees, and age of bearing.

Problems for Study and Discussion

1. What varieties of apples are grown in your community for market?
2. What varieties best suit local soils?
3. Which varieties are least and which most susceptible to diseases?
4. How does ripening season affect your choice of varieties?
5. What ripening seasons best suit your location? Why?
6. How many different varieties would you want in a commercial orchard?
7. Which varieties of pears are most resistant to blight?
8. What varieties of apples and of pears would you recommend for a home orchard?
9. What are the lengths of life of trees of different varieties in your region?
10. Name the leading varieties of apples in order of seasons required before coming into bearing.

Activities.—(1) Visit fairs, fruit shows, and markets and study varieties. (2) Collect specimens of varieties for comparison, and have contests in identifying them. (3) Tabulate local varieties as to season, use, quality, size, color, flavor, and keeping and shipping qualities. (4) Practice scoring fruit with a score card.

Choosing Varieties.—In selecting the varieties of apples for a commercial orchard the grower must be guided by the following factors: (1) the adaptability of the variety to the soil and climatic conditions; (2) the suitability to the market; (3) the season of ripening; (4) the productivity of the variety; (5) whether or not they are early and annual bearers; (6) the quality of the fruit; (7) length of life of the trees; and (8) whether or not the variety is self-fertile.

No varieties of apples or of pears should be selected which are not known to be well adapted to the soil and subsoil and the climatic conditions of the section. The experience of older growers and of the experiment stations should be the guide.

The demands of the market should be studied carefully. The market may refuse to accept a new variety which is better than some of the commonly grown varieties. Talks with commission men and with buyers, visits to markets, and the experience of commercial growers are valuable aids in choosing varieties of apples and pears.

Certain varieties seem to produce fruit in alternate years or do not bear large crops at all. Varieties should be selected which tend to bear fruit each year. Talk with growers about this matter, and about what varieties must be grown together for pollinating. The oldest orchardists should be consulted regarding the vigor of growth and length of life of trees of different varieties. At what ages trees of different varieties may be expected to come into bearing may be approximately determined by studying nursery catalogs, by talks with experienced growers, and by lists issued by experiment stations. Soils and climate affect the age of bearing and also the life of trees.

Varieties of Apples for the South.—It is possible to give a long list of varieties which may be planted but only a few varieties are of commercial importance. The leading commercial varieties are listed. *Summer:* Early Harvest, Transparent. *Fall:* Virginia Beauty, Grimes Golden. *Winter:* Arkansas Black, Winesap, Stayman, Delicious, Rome Beauty.

Other good varieties for home orchards and for local markets include the following: *Summer:* Red June, Red Astrachan, and Horse. *Winter:* Terry Winter, and Yates. Read good catalog descriptions of these and other standard varieties of apples of all seasons.

Varieties of Pears.—The one main problem in the growing of pears is the control of fire blight. Several varieties have been found which are highly resistant to this disease and are gaining favor. The two leading varieties of this kind are the Hood and the Pineapple Sand. The Kieffer is a favorite for the late market but like the Pineapple has poor quality and is not fully resistant to fire blight.

Disease-Resistant Apples.—Some varieties of apples are more susceptible to certain diseases than others. Summaries have been made by experiment stations regarding resistance to scab, blotch, bitter rot, fire blight, and rust. Orchardists setting new plantations should study such tables carefully before buying varieties.

Write to your state experiment station for the very latest evidence regarding disease-resistant varieties of apples and pears. Trials are being made and new data are being gathered.

Variety	Scab	Blotch	Bitter Rot	Rust	Fire Blight
Ben Davis	VS	S	VS	S	R
Delicious	VS	VR	R	R	R
Duchess	VR	VS	O	R	S
Early-Harvest	VS	VS	O	R	VS
Grimes	VR	VR	VS	VR	S
Jonathan	VR	R	VS	VS	VS
Kinnaird	VS	VR	R	R	R
King David	R	R	VS	R	R
Maiden Blush	VR	VS	S	R	S
Paragon	S	R	R	R	R
Red June	VS	R	O	R	R
Rome Beauty	VS	R	R	S	S
Stayman	VR	VR	R	VR	R
Transparent	R	R	O	VR	VS
Wealthy	VR	VR	O	VS	VS
Winesap	S	VR	R	R	R
York	R	R	R	S	VS

Key: V, very; R, resistant; S, susceptible; O, ripens too early for rot.

Job 3. Selecting the Location and the Soil

Conditions Usually Found.—Growers sometimes make mistakes in selecting the proper elevation and character of soil for apples and pears.

Aims.—Students should understand the importance of soil and air drainage and the best types of soil and subsoil for apples and pears.

Problems for Study and Discussion

1. What is meant by air drainage? Show its importance.
2. On what slope would you locate the orchard? Why?
3. What factors would govern the selection of a site on land which is nearly level?
4. Discuss location with reference to spraying and harvesting.
5. Of what importance is the kind of subsoil for an apple or pear orchard?
6. Show the relation between variety and type of soil.
7. Discuss soil drainage for orchards.

Activities.—Make a careful selection for an orchard site on your farm and get the approval of your parents and of experienced growers. Describe the place in class.

Air Drainage.—Apple orchards are usually placed in localities which are rolling. The site for the orchard should be on a slope in order to give good air drainage. Proper air drainage prevents light frosts in the late spring and is often the means of saving a crop of fruit. Do not locate an orchard in a low valley

because cold air settles in such places and may be the cause of frost damage.

Exposure.—A slope to the north or to the northeast is usually to be preferred in order to delay the opening of the buds in early spring. An exposure to the south may cause the trees to bloom before late frosts are over.

Other Factors.—The orchard should be located on a good road, if possible, and near the home of the grower. While the fruit may be hauled with safety for a distance, this increases the expense and adds extra labor at busy seasons.

The trees should be sprayed often if some fruit is to be stored, and all of it must be graded and packed. These matters influence the location of the orchard. Decide where the storehouse, the packing house, and the spraying sheds are to be located.

Soils for apples and pears should be well drained, rather fertile, medium to heavy clay loams. Sandy or sandy-loam soils are not very well adapted for apples or for pears. The apple regions are usually located in mountainous sections or in rolling sections where the soil is usually of a clay loam, underlaid with a clay subsoil.

The content and color of the soil in any region must be considered with reference to the varieties to be grown. The success of previous trials by other growers should be considered.

Job 4. Propagating or Buying Trees

Conditions Usually Found.—Most growers depend upon buying their trees from reliable nurserymen. Few growers know much about the propagation of apples or pears.

Aims.—(1) The student should know how to propagate apples and pears, and (2) how properly to select trees from the nursery.

Problems for Study and Discussion

1. How many farmers of your community propagate apple or pear trees?
2. How are the root stocks grown? When dug? How stored?
3. When is root grafting done? When is top grafting done?
4. Which method of grafting do you consider the best?
5. How and when are scions procured? How stored?
6. How is grafting wax prepared? Waxed knitting cotton?
7. How are the grafts set out in the nursery?
8. What care must be given the trees in the nursery?
9. How may you arrange to get your nursery inspected? Give the purpose.
10. If you are buying trees, from what source will you secure the trees?

11. What size and age of trees would you prefer?
12. Find the cost of such trees.
13. How many trees will be needed per acre?
14. What are the advantages of going to the nursery and making your own selection of trees?
15. List dangers of buying from unreliable agents.
16. Debate: Root grafting vs. budding for apple trees.
17. Debate: Propagating vs. buying nursery trees.
18. Debate: 1-year-old vs. 2-year-old trees for setting in orchards.

Activities.—In the shop make a grafting bench similar to a cobbler's bench.

Propagating Apples and Pears.—These fruits may be propagated by budding or by grafting. Grafting is the more common method of propagation as much of the work may be done indoors in the winter season. If apples are budded the work is usually done in the fall after the seedlings have grown for the first season. These buds remain dormant until the following spring.

Root Grafting.—The method commonly used for propagating apples and pears is by tongue-grafting of seedling roots, using scions from desirable trees. The seeds, as from cider mills, are planted in the early fall or spring and the seedlings dug the following fall. The tops are cut off, and the roots tied in bundles and stored in a cool place in moist sand or moss. The grafting may then be done in a cellar or other cool place at any convenient time during the winter.

Scions are selected from the best bearing trees of the desired variety and from growth of the past season. The roots are used whole or cut in pieces six inches in length, if extra good. The root is prepared by making a long, sloping cut on the upper end, using a sharp knife, and then a slit two-thirds of the way from the lower end of the cut to form the tongue. The scion is cut in exactly the same manner, except that the cut is made on the lower end. The tongues thus formed in the root and in the scion are slipped under each other and pushed up so that the cambium layers of the two come together on both sides if possible, or on one side. The graft is wrapped with No. 18 knitting cotton or with thin bands of muslin cloth which have been dipped in melted grafting wax. No tying is needed. The wrapping holds the two parts together and helps to keep out moisture. The grafts, when labeled, are tied firmly in bundles

of twenty-five and stored as were the roots and scions, until spring.

These grafts are set in nursery rows, leaving only one or two buds of the scion showing above the ground. They may grow well if set six or eight inches apart in rows three and a half feet apart. Watch for possible constriction by the wrapping, and cut the bands if necessary. They are given clean cultivation and are fertilized well to produce good growth for one season. If left a second season, they should be thinned and properly pruned to form a balanced set of branches.

Preparing Grafting Wax.—Grafting wax is made from three main materials: four parts resin; two parts beeswax or paraffin; and one part of oil or grease. The consistency can be made to suit by using more resin for a hard wax for warm weather, or more grease for a soft wax. The grease may be tallow, linseed oil, lard, or axle grease. Heat these materials in a tin bucket or pot, adding them in the order given, until melted. Stir well and pour the melted mixture into a pan of cold water. Grease the hands carefully and pull the wax as you would taffy candy.

Skeins of No. 18 or 20 knitting cotton, wound so as to be easily cut about eight inches long, may be dipped in the hot wax and then used for wrapping root grafts.

Nursery Inspection.—In most states a nursery inspection law is in force, making it necessary for the nursery to be inspected once or twice each year if any of the trees are to be sold or shipped. The inspection tags state that the stock has been inspected and has been found free from insects and diseases.

Number of Trees Needed.—The number of trees needed per acre depends upon the distance between trees and upon the method used in laying out the orchard. Apples are usually planted from thirty to forty feet apart each way and pears from sixteen to twenty feet each way. Calculate the number of trees per acre by the rule in the Appendix.

Age of Trees for Planting.—The points in favor of one-year-old trees for planting in orchards are as follows: (1) They may be transplanted more successfully. (2) They may be pruned or headed to suit the orchardist. (3) They are more easily shipped and handled. (4) They cost less, as they have grown in the nursery only one year. Objections to buying two-

year-old trees from nurseries are the extra cost and the fact that they are likely to be culls or left-overs from the preceding year's business.

Buying Nursery Trees.—Several points besides age of trees should be kept in mind: Visit nurseries to inspect trees, to study varieties and methods of keeping variety names true, and to become acquainted with the nurseryman. Irresponsible agents may give trees the wrong names, sell diseased trees, handle trees badly, charge high prices, and commit worse offenses or frauds. Examine trees for diseases and insects such as root aphids and crown galls. Compare and study the character of growth, the color of bark, the quality of roots, and other differences between varieties ordered. Place orders for trees as long in advance as possible.

Care of Trees upon Arrival.—Bundles or boxes of trees should be opened as soon as possible. Heel-in the trees immediately. Select a place near the field to be planted. Dig a trench, in the shade if possible. Untie the bunches if large. Place the roots against the moist soil in the trench, and cover them well with moist soil, leaving the tops in a sloping position.

Job 5. Preparing the Soil and Laying Out the Orchard

Conditions Usually Found.—The soil is usually well prepared before an orchard is set; most orchards are laid out on the rectangular plan.

Aims.—Students should know (1) how to prepare the soil before setting an orchard; and (2) how to lay out the orchard for planting.

Problems for Study and Discussion

1. Enumerate advantages of fall planting. Of spring planting.
2. How long before planting time should the soil be plowed for fall planting?
3. Find how deep growers plow the soil.
4. What implements should be used after plowing the soil?
5. Outline a good plan.
6. Of what importance is plenty of organic matter in the soil?
7. Outline a plan for obtaining a crop of green manure to plow under.
8. Describe the rectangular method of laying out an orchard.
9. Outline the triangle or hexagon method.
10. How may a plow be used in laying off rows?
11. Describe the staking plan of marking places for trees.
12. Under what conditicns should the terrace plan of planting be followed?
13. How are the rows laid out for this plan?
14. What methods are used in your region?

Activities.—Set stakes for trees. Run terrace lines on sloping places. Make an accurate right triangle, 6 x 8 x 10 feet, for use in making true corners in the orchard.

Preparing the Soil.—If the apple or pear orchards are to be set during the winter months, soil should be prepared in the fall. It is a good practice to turn the soil six to eight inches deep with a turning plow a few weeks before planting and then disk or harrow just before the trees are to be set. All crop wastes and manure should be turned under well.

Green Manure or Other Organic Matter.—Young trees need an abundance of nitrogen to stimulate growth. This is best supplied in the form of organic matter which may be turned under when the soil is being prepared for planting. If this is a good growth of a leguminous crop, so much the better. If plenty of barnyard manure is available it may be used in a somewhat rotted condition, and may be applied in and near the tree rows.

Methods of Laying Out Orchards.—The different systems now used in laying out apple and pear orchards are (1) the square or rectangle, (2) the triangle or hexagon, and (3) the terrace. The triangle method is seldom followed.

Most growers use the square or rectangular method. Lines are run at right angles to each other from one corner. Form a right angle by the 6-8-10 rule, measuring 6 feet on one line, 8 feet on the other, and making the hypotenuse 10 feet. Stakes are then driven in the soil at the proper intervals desired for the trees. By using a line or a pole to measure from the stakes in these two lines it is possible to locate all of the trees in the orchard. Sometimes a furrow is plowed for each row of trees in one direction. Stakes are usually placed also.

For very steep land it is sometimes desirable to use the contour or terrace method. The trees are set along contour lines. If a line of stakes is run around the middle of the hill, the other lines may run parallel to this, or nearly so.

Job 6. Planting the Trees

Conditions Usually Found.—Growers often do careless planting and many trees die or make poor growth due to improper handling at planting time.

Aims.—The young orchardist should know how to organize a planting job to be able properly to plant the trees.

Problems for Study and Discussion

1. Of what value are fillers in an apple orchard?
2. By what method would you dig the holes for the trees?

3. Discuss the value of dynamiting the holes.
4. Describe how the holes should be dug with hand tools.
5. Tell how to make a planting board.
6. Describe the use of a planting board in setting trees.
7. At what time of year would you set trees? Why?
8. Describe the procedure to follow in setting a tree.
9. Give directions for root pruning at planting time.
10. Discuss the pruning of trees being set in the orchard.
11. Describe the handling of trees to protect roots at setting time.

Activities.—Make a planting board in the shop. Practice setting trees with and without the use of a planting board. See figure in Citrus Enterprises.

Fillers.—When the planting is done according to the filler system, trees which are to live the longest and become the largest in size are selected as permanent trees. These are usually apple trees which do not bear young. They are planted in the odd-numbered holes in the odd-numbered rows only. Filler trees are planted in the other holes. This makes three times as many fillers as permanent trees. Draw a square orchard to show this.

The points in favor of the filler system are (1) closer planting than if all were permanent; (2) less need of using the intercropping system; and (3) earlier returns from the orchard than when only permanent trees are used. The points against using fillers are (1) fillers may be allowed to crowd the permanent trees by not being cut soon enough; (2) the blossoming and spraying dates for permanent trees and fillers may not coincide, making the work more difficult; (3) the picking is more difficult; (4) soils and fertilizers seldom suit both types of trees.

Digging the Holes.—Deep, wide holes should be dug so that the roots of the young tree may spread out in a natural position. As the holes are dug it is the usual practice to place the topsoil in one pile and the subsoil in another. The holes are dug from fifteen to twenty inches across and about the same in depth. In most cases, a shovel and a spade are the tools used for this. Some growers use dynamite to open holes and loosen the subsoil but the practice has not met with favor except to break through hard-pan subsoils.

Pruning at Planting Time.—The main pruning needed at the time of planting is to trim the roots and the top. Cut off all diseased or broken roots and any that are too long. In pruning the top of one-year-old trees all that is necessary is to

cut the top back to about thirty inches above the ground after the setting is finished.

If two-year-old trees are planted, more care is needed in pruning the top because the side branches are already formed. Try to select three or four well-formed side branches so that the tree will be balanced and prune the top and the branches back somewhat. Such pruning is more rapidly done before trees are set. Growers now practice rather low heading of trees, which makes spraying and harvesting much easier, and keeps cultivating tools away from the trees.

Setting a Tree.—The hole for planting a tree should be dug as already described. Set the young tree in the hole one to two inches deeper than it grew in the nursery. It is a good practice to use a planting board to get each tree in the exact position desired. (See Citrus Enterprise.) When the tree is in position, throw a few shovels of the topsoil around and over the roots and pack this well. Add more topsoil and pack again. When the hole is about half filled, a little well-rotted manure may be used if desired. Fill the hole to the top and pack, leaving one or two inches of the loose soil scattered over the top to form a mulch. In spring planting, if the weather is dry, a depression may be left near each tree to receive extra rain water. If the weather is dry, a gallon or more of water should be poured in at planting time. If water is used, it should be allowed to seep into the soil before the hole is filled. Trees should be transported to places in the orchard in barrels of water, or wrapped well in damp burlap.

Job 7. Cultivating the Orchard; Growing Intercrops

Conditions Usually Found.—(1) Most growers find that it pays to cultivate the orchard. One of the common causes of failure with orchards is lack of cultivation. (2) Intercrops are often grown in young orchards.

Aims.—(1) Students should understand the purposes and methods of cultivation and the best implements to use. (2) They should know the value of intercrops and what crops to grow.

Problems for Study and Discussion

1. How many growers in your community practice growing intercrops in the orchard?
2. Give the benefits of intercropping.
3. Give its dangers.
4. What intercrops would you think best for this purpose?
5. What winter cover crops would you recommend for the orchard?

6. When and how is this plowed under or otherwise disposed of?
7. How many growers in your locality practice clean cultivation?
8. Describe a good annual plan of tillage.
9. Debate: Clean cultivation vs. the growing of some permanent grass sod in the orchard.
10. What implements are best for cultivating the orchard?
11. How are diseases and insects affected by cultivation?

Intercropping Young Orchards.—Where clean cultivation is to be practiced, many growers plant some crop requiring tillage between the trees in a young orchard. The crops grown be-

FIG. 127.—Three-year-old pear orchard, intercropped with cabbage. Texas scene, Rio Grande valley.

tween the young trees should help pay for the cultivation and should not injure the trees if the proper care is given during cultivation. The crops selected for this purpose are usually quick-maturing, low-growing truck crops. Early Irish potatoes, early cabbage (Fig. 127), snap beans, onions, beets, and other similar crops may be used.

Methods of Cultivation.—The two general plans of orchard management are clean cultivation and sod mulch. Growers who practice clean cultivation claim the following advantages: (1) It destroys many harmful insects. (2) The roots of the trees go deeper in the ground and are better able to stand dry weather. (3) More plant food is made available. (4) Cover crops may be used as green manure. (5) The fruit is of a better quality and larger size due to more plant food being available. (6) Yields of marketable fruit are greater.

The advantages of sod culture include these points: (1) The expense of cultivation is saved each year. (2) The soil will not wash as much as in clean cultivation. (3) The trees may be injured less where cultivation is not given. (4) Fruit in some cases will color better.

Cover Crops for the Orchard.—If clean cultivation is practiced it is possible to use a summer growth or a winter cover crop as green manure. For summer legumes to grow between the trees, cowpeas or soybeans are commonly used. For winter cover crops, crimson clover and winter vetch may be used, and non-legumes, such as rye, oats, or rape, may be grown with

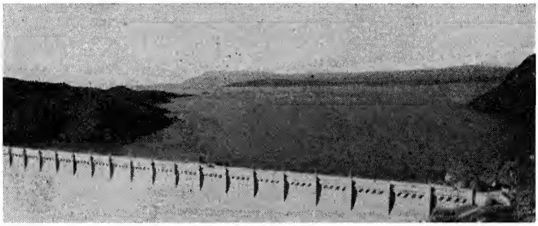


FIG. 128.—The Elephant Butte irrigation dam supplying water for irrigation of horticultural projects in the Rio Grande Valley, Texas.

them. Rye and vetch and crimson clover are often mixed together in seeding orchards for a winter cover crop.

The main advantages of cover crops are (1) to add humus and nitrogen to the soil; (2) to improve the physical condition of the soil; (3) to retard washing; (4) to prevent leaching; (5) to check the fall growth of the trees; and (6) to increase the water-holding capacity of the soil.

Irrigation of orchards and truck crops, where it is possible, makes growth independent of dry weather (Fig. 128).

Job 8. Pruning the Orchard

Conditions Usually Found.—Commercial growers have found that pruning pays, but home orchards are often neglected.

Aims.—The student should know the reasons for pruning, and how to prune apple and pear trees.

Problems for Study and Discussion

1. At what time of the year should pruning be done?
2. What are the different reasons for pruning an orchard?

3. What information concerning the fruiting habits of an apple tree should a person have before he starts to prune?
4. What do we mean by low-headed and by high-headed trees?
5. Debate: Low heading vs. high heading.
6. Why is it important to prune before the spraying is done?
7. What pruning tools would you need in the apple orchard?
8. Make a list of the main points to observe in pruning a young tree; a bearing tree.
9. What should be cut out?
10. Give directions concerning how cuts should be made.

Activities.—Practice pruning young and old orchards of several kinds. Keep tools sharp by doing shop work in advance.

Reasons for Pruning.—The main reasons for pruning apple or pear orchards are as follows: (1) to thin the fruit; (2) to stimulate new growth so that a tree will bear annually; (3) to help in the control of insects and diseases; (4) to facilitate spraying so that it may be more thorough; (5) to control shape of trees; (6) to aid the picker in harvesting fruit; and (7) to prevent the breaking of the fruiting limbs.

Fruit Buds.—In pruning apple and pear trees of bearing age one should keep in mind the fruiting habits of these fruits. The fruit buds of peaches are borne on the wood of the past season's growth, while on apples and pears the fruit buds are found near the ends of fruit spurs.

Amount of Pruning.—The amount of pruning needed depends upon the age of the orchard, the system of pruning followed, and the fertility of the soil. Young trees often need more attention than bearing trees. Growers have found, however, that severe pruning of apple and pear trees is not necessary, but that the thinning out of limbs is desirable.

Shaping young trees is accomplished by properly selecting limbs at different heights and extending in three or four different directions to form the main frame-work of the tree. Start the plan the first year and try to conform to this each year. (Fig. 129.)

Remove by pruning all diseased limbs; broken limbs; those which rub each other; those which are parallel and close enough to compete for light and air (Fig. 130); those showing weak growth; limbs which cross each other; those which cross the head of the tree; and water sprouts which are so located as to rob the fruiting wood. Prune back new growth enough to keep the shape or form of the tree as desired.

FIG. 129.—Young apple tree before and after pruning. Open center form. (S. C. Exp. Sta.)

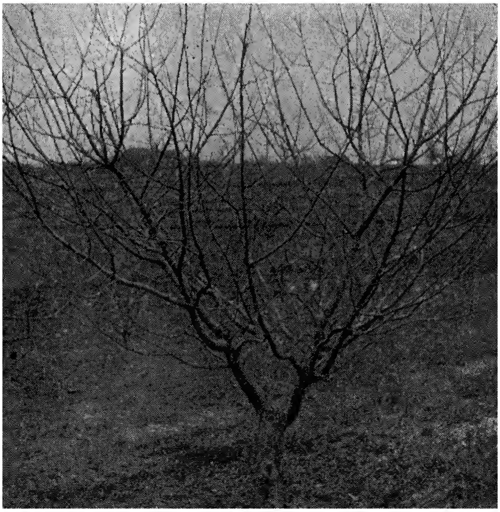


FIG. 130.—The open-center type of training apple trees. This tree is ready for its annual winter pruning with small hand shears to thin the small branches. (S. C. Exp. Sta.)

How to Prune.—Make all cuts smooth and close to the parent trunk or limb. Avoid cutting large limbs if small cuts will do. Small wounds heal more easily than large ones. Paint large wounds with any common paint—not tar paint. (Fig. 131.) When cutting back the top, cut at a fork.

Time to Prune.—Apple and pear orchards are pruned chiefly while the trees are dormant. The exact months will vary for the different sections but December and January are the months used by most growers. The orchard should be pruned before the winter spray is applied. This is necessary in order to give a more thorough spraying as well as to save time and spray materials.

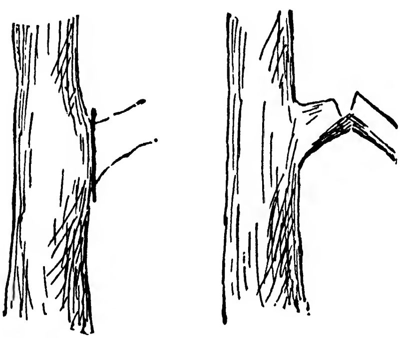


FIG. 131.—Good and bad pruning contrasted. Cut close when removing large limbs. Cut from the under side first to prevent splitting down the bark.

Some light pruning may be done in the summer to control the shape of young trees. Summer pruning is often best for removing twig blight, blotch, and canker.

Pruning Tools Needed.—For pruning the apple or pear orchard a person needs the following tools: (a) hand shears, (b) lopping shears, (c) a pruning saw, and (d) a pole pruner.

The hand shears are used for thinning small limbs or for cutting back limbs that are not over one-half inch in diameter. The lopping shears are used for cutting limbs which are too large for the hand shears. The pruning saw is used for removing limbs too large for the lopping shears. Saws on long handles are now sometimes used for high limbs. The pole pruner is used to head back high limbs which cannot be reached with short-handle tools.

In buying pruning tools it is best to purchase the best grade of steel. The cheap tools will not cut after the first few days of pruning, while good tools should last for years, and will remain sharp longer.

Job 9. Providing Plant Food; Fertilizing

Conditions Usually Found.—Growers have found that it is profitable to use fertilizers for apple and pear trees.

Aims.—Orchardists should understand how to fertilize both young and old orchards economically and successfully.

Problems for Study and Discussion

1. What fertilizers are used for orchards in your community?
2. What kinds of green manure crops are used?
3. When should this be sown? When plowed under?
4. How may a grower tell when his trees need more plant food?
5. What are the indications for need of nitrogen?
6. What are the special effects of phosphoric acid?
7. What kinds of commercial fertilizers would you recommend for a young orchard?
8. With what fertilizers would you supplement a green-manure crop in a bearing orchard?
9. How is the fertilizer applied for best results?
10. At what times of the year should applications be made?
11. Calculate amounts of fertilizer per tree to be used under different conditions.

Green Manuring.—When soil is being prepared for the orchard green manure should be turned under. The soil will usually be improved by using green manure each year. This is produced by growing a winter cover crop each year or by a summer catch crop in some cases. The values of cover crops have already been listed. The benefits of green manure are much the same.

Fertilizing.—In addition to green manures, many growers find that it is necessary to apply commercial fertilizers. The kinds and the amounts of fertilizers needed vary from one soil to another. As a general rule, heavy soils in the mountainous sections are high in potash, low in phosphorus, and high or low in nitrogen, depending upon the amount of organic matter present. Fertilizers such as phosphoric acid and nitrate usually prove profitable.

Applying Plant Food.—The fertilizers may be applied by hand around each tree in a young orchard or with a fertilizer distributor in a bearing orchard.

For early varieties of fruit the plant food is sometimes given to the trees as soon as harvest is over. If it is immediately available and if the moisture and tillage are favorable, the trees should produce their buds and store food for the early crop next season. Some additional fertilizer may be applied in early

spring when leaves are first formed. The latter should be rich in phosphorus. Late varieties should be chiefly fertilized in the spring and early summer.

Job 10. Controlling Diseases and Insects

Conditions Usually Found.—Much loss occurs from orchard enemies. Growers have to put up a continuous fight to hold diseases and insects in check.

Aims.—The orchardist should be able to identify each disease or insect pest, and know what control measures to use.

Problems for Study and Discussion

1. Make a list of the orchard diseases most common in your community.
2. Make a list of the insects which damage apple or pear orchards.
3. How do growers control twig blight?
4. How do they control canker and sun scald?
5. Describe the effects of blotch disease.
6. Discuss varieties with reference to this disease.
7. How would you recognize bitter rot?
8. What varieties are most subject to bitter rot? Which are most immune?
9. Prepare a spraying schedule for controlling the different diseases.
10. How much damage is done in your community by the codling moth? Describe this.
11. State the methods used for control of the codling moth.
12. What damage is done by apple borers? Describe the two common forms.
13. How are they controlled?
14. How do tent caterpillars injure trees?
15. Prepare a spray schedule for insect enemies which may be combined with the spraying for diseases.

Activities.—Repair and test spray equipment in advance. Collect specimens of the different apple and pear insects, and of the effects of diseases. Preserve these for use and reference.

Fire Blight.—This is often called twig blight or pear blight, and is very serious in the South on apple and pear trees. The disease is believed to be caused by bacteria which work under the bark. The first sign of the disease is usually the wilting of leaves and twigs. This may be followed by the whole limb dying. In many cases, the disease starts in the blossom clusters and may be caused by the visits of insects. In most cases, a liquid is exuded from diseased tissues and is carried by insects to other parts or to other trees as infection. Control insects well.

During the dormant season cut away all affected twigs and cankered parts. Remove diseased parts as soon as possible and treat the wounds and tools with bichloride of mercury. For

pears, such varieties as the Hood and others which are resistant to this disease are recommended. Check unusual growth.

Blotch may be found on the fruit, leaves, twigs, and limbs. It causes considerable damage. The disease is first detected as star-shaped black spots on the fruit. The spots often cover the entire fruit. The blotch spots on the twigs become rough or cankerous; here the spores live over winter.

Cut out canker spots in winter to destroy spores. Spray fruit with Bordeaux mixture about three weeks after the petals fall. Repeat to keep the new growth protected. Continue spraying until fruit is well grown. Grow resistant varieties, as Grimes Golden.

Bitter rot is a very common disease in the South. The fungous growth first appears as small spots on the fruit, which later enlarge and turn dark in color. These areas appear sunken and reach to the center of the fruit. The disease may also attack the twigs and the limbs, appearing as sunken cankers with split bark.

The control measures are to remove all of the cankers on the tree and all diseased fruit and to spray diligently. As the disease starts on the fruit in the spring it may be held in check by persistently spraying with Bordeaux mixture. Some varieties are more susceptible than others. (See Job 2.)

Cedar rust is a very serious disease which attacks the leaves and twigs. It is sometimes found on the fruit also. The tree is weakened by the disease because the leaves usually fall when attacked. This disease has an alternate generation which develops on cedar trees, causing a growth known as "cedar apple." The disease cannot come from the apple orchard but is always spread from cedar trees. The control measure is to destroy all cedar trees within one mile of the orchard.

Scab.—This disease attacks the leaves, twigs, and fruit. It may be noticed on the leaves and on the fruit as small circular or oval spots. These spots later turn dark and often cause the skin to crack. The disease is usually worse during warm, moist weather, but orchards seldom are free from it. Scab may be held in check by spraying with lime-sulfur or with Bordeaux mixture while fighting other enemies. (Fig. 132, p. 294.)

Codling Moth.—This is one of the worst insect enemies of the apple. The adult moth lays her eggs in the early spring

in the blossoms, on the twigs, or on the young fruit. As soon as the larvæ are hatched they eat their way towards the center of the fruit, often entering at the calyx. When they are full grown they fall to the ground by means of web fibers, if the fruit has not already dropped. The larvæ make their way from the ground to the trunk of the tree, spinning their cocoons in

FIG. 132.—The cluster formation of apples when not properly thinned. The spraying has prevented diseases and insect injury. A north Georgia orchard. (Seaboard A. L. Ry.)

the crevices of the bark. Often three or four broods are produced during the year to infest the fruit.

The control measures are to spray with arsenate of lead at intervals of two or three weeks, beginning in the spring when the petals fall and continuing until about six weeks before harvesting time. (Fig. 133.) Clean cultivation may destroy many fallen fruits containing larvæ.

San José Scale.—This serious scale may be noticed when the trees are dormant, appearing as small, circular, yellowish insects, covered with grayish scales. When enough scales are present, the whole limb or tree has a grayish appearance. The scale insects damage the tree by sucking the sap.

San José scale may be controlled by spraying the tree in the dormant stage with winter strength of lime-sulfur or with oil emulsion. In cases of bad infestation the oil emulsion is used in early winter and lime-sulfur is used in late winter. (Figs. 134, 135, and 136.)

Apple Borers.—The two common borers are the round-headed and the flat-headed borers. Borers in the larva stage work up and down in the sap wood and finally into the heart wood the second season, usually near the soil. The flat-headed borer is

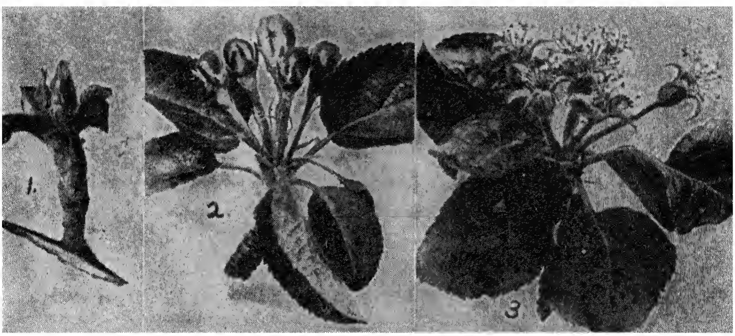


FIG. 133.—Three stages for spraying apple and pear trees. 1. Winter buds bursting: spray for scab, aphids, and bud moth. 2. Pink or pre-blossom: spray for scab, and worms of several kinds. 3. Calyx: spray for scab and codling moths.

waxy white in color in the larva stage and bores into the large limbs or into the trunk of the tree.

The only method of control of these borers is to dig them out with a sharp knife or other tool. Washes such as lime-sulfur or regular whitewash are sometimes used as repellents against the adult beetles before they lay their eggs.

Woolly Aphis.—These insects may be found on the branches in cottony masses. On opening one of these masses one finds clusters of reddish-brown aphids or plant lice. These masses are often seen on water-sprouts. A root form of this aphis causes galls and swelling on the roots, and trees suffer severely from the attacks. Spraying with nicotine sulfate will kill insects on the bark. Trees having root galls should be dug up and burned. The soil should be used for other crops.

Canker worms are noticed in the form of slender "measuring worms." They eat the leaves, and sometimes greatly re-

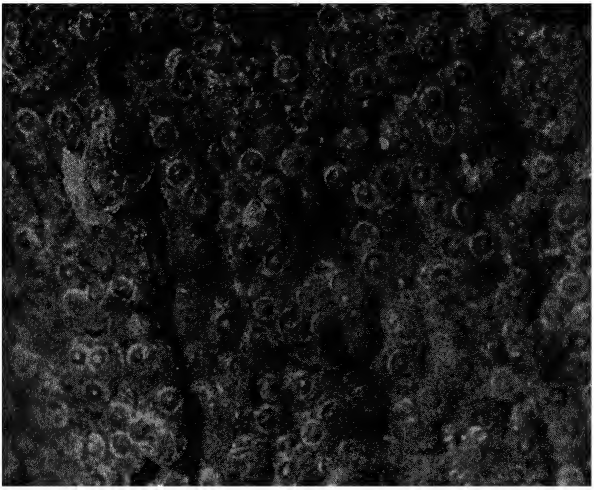


FIG. 134.—San José scale on twigs as seen under magnifying lens or microscope. (Kentucky Exp. Sta.)

FIG. 135.—Agricultural students spraying for scale on apple trees in an orchard project.

duce the leaf surface of trees. They may be controlled by strong solutions of arsenate of lead.

Tent caterpillars are familiar to most orchardists. Arsenical sprays are very effective against these leaf-eating insects.

Job 11. Making Spray Material and Spraying

Conditions Usually Found.—Growers usually find it profitable to mix their own spray materials. A few buy patent preparations for small orchards.

Aims.—The orchardist should understand how to prepare the various spray mixtures, and how to apply them.

Problems for Study and Discussion

1. Find the number of growers in your community who prepare spray materials at home.
2. How are Bordeaux mixture stock solutions prepared and kept?

FIG. 136.—Winter spraying of project apple trees for control of scale insects.

3. How do you mix the stock solutions just before spraying?
4. How is miscible oil used in spraying?
5. Give formula and directions for preparing an oil emulsion stock solution, and tell how to dilute it.
6. How is home-boiled lime-sulfur prepared?
7. Give directions for testing lime-sulfur solutions for winter use. For summer use.
8. How would you mix arsenate of lead with Bordeaux mixture for spraying apples and pears?
9. What are the different types of insecticides and fungicides?
10. Give several examples of the uses of each type.
11. How would you use nicotine sulfate for spraying plant lice?
12. What spray equipment would you recommend?

Activities.—(1) Prepare a spray schedule in chart form for apples and pears. (2) Practice making Bordeaux, lime-sulfur, oil emulsion, and other

spray materials. (See Appendix.) (3) Adjust and repair spraying equipment, and practice using it.

Kinds of Spray Materials.—There are two general classes of spray materials: (1) fungicides, used in the control of various fungous diseases, and (2) insecticides used for killing insects. Insecticides may be divided into two groups or classes: (1) poisonous sprays, used for controlling chewing or biting insects, and (2) contact spray materials, used for controlling sucking insects. (See formulas in Appendix.)

The common poisonous materials used as sprays or in dust form are arsenate of lead, Paris green, and arsenate of lime.

Contact spray materials are nicotine sulfate, miscible oils, kerosene and oil emulsions, lime-sulfur, soap mixtures, and a recent introduction, DDT. Various dusts, such as pyrethrum, tobacco, and nicotine sulfate may be used.

The fungicides usually consist of sprays or dusts of copper compounds or sulfur preparations. These sprays include: Bordeaux mixture, commercial lime-sulfur, home-boiled lime-sulfur, and wettable sulfurs.

Making Bordeaux Mixture.—This standard fungicide is made up of copper sulfate (bluestone), lime, and water. The usual formula is two pounds of copper sulfate, three pounds of hydrated lime, and fifty gallons of water. Powdered copper sulfate is the most convenient form to use. With powdered copper sulfate, it is unnecessary to make up a stock solution and all mixing can be done in the spray tank. To mix in a power sprayer, with enough water in the tank to barely cover the agitator blades, start engine and agitator. Sift into the spray tank the required amount of powdered copper sulfate, which will dissolve very quickly. While continuing to fill the tank with water, sift in the lime (agitator still running for thorough mixing). If lump or granulated copper sulfate is used, it will be necessary to dissolve the crystals and then pour the solution into the tank. With stirring, the granulated copper sulfate may be dissolved rather quickly in hot water. If the lumps are used, the copper sulfate should be placed in a burlap bag and suspended just below the surface of the water in a wooden container. Usually the quantity placed in the bag will be equivalent to one pound for each gallon of water in the container.

To make good Bordeaux one needs only to follow the rule of

adding the concentrated lime to a dilute solution of copper sulfate. Use bordeaux as soon as prepared; do not allow to stand in the spray tank over night. Use wooden or paper containers for storage of the dry copper sulfate, and wooden containers for copper sulfate solutions, since the material will corrode iron or steel containers.

Dust Applications.—Dust applications are sometimes used to supplement or even to take the place of liquid applications, except for dormant sprays to control scale insects. Sulfur dusts, with or without arsenic, may be purchased. Copper dusts may be obtained for use when certain diseases must be combated. In general it may be said that dusts are not so effective as liquid applications in the apple or pear orchard. Usually when dusts are used instead of liquid sprays, it is necessary to apply the dusts twice as often as the liquid that normally would be used in order to obtain results that are comparable.

Spray Equipment.—In orchards growers use either barrel sprayers or tank sprayers. Barrel sprayers are easily carried in wagons or trucks. A hand spray pump is bolted to a barrel and has either one or two lines of hose connections.

Several types of tank sprayers are in use. In some cases a suction hose leads from the tank to the pump. Special agitators are provided. The pumping may be done by hand, but the usual plan is to provide a gasoline engine for this purpose. High pressure is needed.

Success in Spraying.—The right time to spray should be watched closely to control enemies. Bright weather is best and high wind should be avoided. If rain washes off material before it dries, the application should be repeated. All surfaces of the tree should be covered well. Materials should be the right kinds to suit the purposes and must be properly made.

Spray Schedule for Apples and Pears.—Conditions encountered in the various areas in which apples and pears are grown in the southern states vary so greatly that no one spray schedule could be prepared which would prove to be most effective and at the same time most economical under all of the conditions. Under some conditions specific diseases or insects will present special problems requiring variations from the usual course of action. Bitter rot, for example, is a much greater problem in some areas than in others because of the varieties that are grown.

In general, it may be said that the spray schedule required in a farm orchard will be quite different from the schedule required in a commercial planting.

The Agricultural Extension Service in the various states will provide information on the spraying of fruits which is based upon research and observation under the conditions existing in the various areas of the individual states. It is suggested, therefore, that such information be obtained through this Service.

Do not depend upon the same spray schedule over a period of years. Contact the Extension Service each year before the spraying season begins and obtain the most recent revision, for changes are made frequently in such schedules because of the introduction of newer and better materials and the finding of ways to use more effectively older spray materials.

Job 12. Renovating Old Orchards

Conditions Usually Found.—In many localities neglected orchards are to be found which may prove profitable if properly treated.

Aims.—How to renew old orchards without too great expense and without too much loss of cropping returns should be understood.

Problems for Study and Discussion

1. Find the number of apple or pear orchards in your region which need renewing.
2. What are the different steps in renovation which might be used?
3. What bad effects may result from too heavy pruning? Describe these.
4. Give guiding rules for proper pruning.
5. How would you spray an old neglected orchard?
6. What extra spraying may it need as compared with other orchards?
7. Discuss the resetting of trees in an old orchard.
8. Give directions for the use of nitrogen for a neglected and newly pruned orchard.
9. How would you make use of phosporic acid and of potash?
10. Discuss cultivation for a neglected orchard.
11. What green manure should be used?
12. Discuss the changing of varieties in an old orchard.

Renewing Old Orchards.—In most communities are to be found neglected home or commercial orchards which may be made profitable. Where the trees are still standing it is usually possible to renovate the orchard. In renewing old orchards there should be several steps: (1) pruning; (2) spraying; (3) cultivating; (4) fertilizing; (5) sometimes working over trees by budding or by grafting; and (6) resetting trees.

The pruning for an old orchard should consist of cutting out all diseased or dead limbs and the thinning of any cross

branches. Do not prune too severely because new growth may be stimulated enough to delay the bearing of fruit for several years. Avoid heavy topping back, and do not remove too many large limbs.

The spraying should be done as recommended in the regular spray schedule. At least one additional spray should be given. This may be an early winter spray of oil emulsion for scale, or the first spray in the schedule may be used just as soon as the trees are pruned and then the spraying followed as recommended in the spray schedule.

The cultivation in an old orchard should be shallow for the first year. Turn under the old sod but do not add much other organic matter until bearing begins again.

Fertilizing.—Pruning stimulates new growth but some commercial fertilizer will usually be needed. Avoid using much nitrogen alone. It should be balanced with materials rich in phosphorus. Apply amounts as recommended for the bearing orchard. (See Job 9.)

Changing Varieties.—In some cases it may pay to top-work the old trees, changing to some more profitable variety. The form of grafting commonly used is the cleft graft. This delays cropping and is very expensive. In some cases results of top grafting of apple trees to change to a different variety are very satisfactory. Cleft-grafting methods are shown (see Index).

Resetting trees in an old orchard is always a debatable problem. Root parasites, soil exhaustion, and spread of insects and diseases from the old trees to the young ones are the difficulties to be met. Under favorable circumstances some resetting of trees may be advisable.

Job. 13. Harvesting the Fruit

Conditions Usually Found.—Much fruit is harvested by poor methods. Commercial growers find it profitable to take special care in harvesting the fruit.

Aims.—The need of careful picking of apples and pears, and how to do the work successfully and economically should be understood.

Problems for Study and Discussion

1. What picking equipment is needed for apples and pears?
2. How can a grower tell when to pick the fruit?
3. Compare maturity for picking pears, early apples, and late apples.
4. How is the fruit actually picked from the trees?
5. Compare the methods used for harvesting pears with those for apples.
6. Compare different types of vessels for picking.

7. What type of ladder would you prefer for large trees?
8. How are apples and pears carried to the packing house?
9. Of what importance are weather conditions in harvesting the fruit?

Activities.—(1) Make lined barrels or orchard lugs. Make apple-picking ladders. (2) Practice picking fruit of several kinds. Keep records of the work and determine the cost.

Picking equipment consists of ladders on which to stand for picking the fruit, picking bags or containers, boxes or barrels for carrying the fruit to the packing house, and a wagon or truck with the proper frames for hauling the fruit to the packing house.

Ladders are of two types: (1) a step ladder with three legs, one leg being in front to help the picker in getting into the tree more easily; and (2) a ladder which has two legs far apart at the base and a pointed top for leaning against the tree.

Picking receptacles include various forms of bags, galvanized iron pails, and oak-staved baskets with bail handles. The baskets are probably used more than the other two. The objection to bags is the danger of bruising the fruit.

A basket made of oak staves, which has a strong bail handle and holds about a half-bushel, is probably one of the best containers for use in picking. Often the basket is lined with some heavy cloth to prevent injury to the fruit. Strong metal pails are often used.

Lugs or containers for carrying the fruit to the packing house may be large baskets, various forms of boxes, usually large in size, or common apple barrels.

Fruit Trucks.—It is well to equip wagons with springs to reduce the damage caused from bruises to the fruit. Frames which are especially suitable for use in hauling the fruit are usually constructed for the wagons and trucks. Such frames are wide and constructed as low as possible to help in loading the fruit.

Judging Maturity.—The exact maturity for picking apples depends upon whether or not the fruit is to be shipped to market and how far it is to go. Apples are often marketed green in the early part of the season, but later the fruit is picked about the time it is turning to its ripe color, and when the stems separate from the spurs readily.

Pears are often picked before they are ripe and placed in a dark place to ripen. Such a plan actually improves the flavor and the texture.

Picking the Fruit.—Fruit should be picked from the trees by hand and placed in suitable containers. Windfalls are bruised and are not fit for market. They may be used for immediate cooking.

The fruit is picked by grasping it and giving a quick side twist. The stem is left on the fruit. Early varieties are sometimes harvested at two pickings, but one picking is the rule for others.

Job 14. Grading and Packing the Fruit

Conditions Usually Found.—Many growers fail to grade the fruit to best advantage. Commercial growers usually take special care in grading and packing the fruit properly.

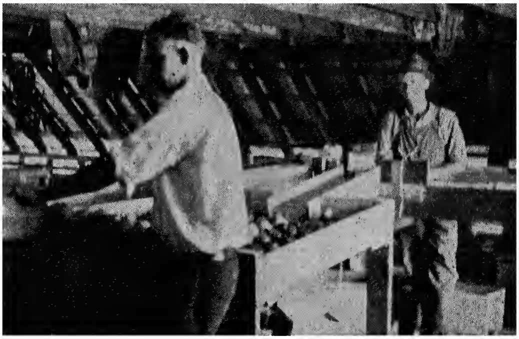


FIG. 137.—Students grading and packing apples with homemade equipment.

Aims.—The student should develop skill in grading and packing apples and pears.

Problems for Study and Discussion

1. How many grades of apples and of pears do you find on the market?
2. Define the standard grades of apples; of pears.
3. How are apples sized at the packing house?
4. How is the other grading done?
5. Describe the grading of pears.
6. Discuss the location of a packing house.
7. Of what size should the packing house be?
8. What containers are used for packing apples and pears?
9. How are apples packed in boxes? Describe different packs.
10. Discuss the wrapping of these fruits for fancy markets.
11. How is the fruit packed in barrels?

Activities.—Make a burlap-lined grading frame in the shop. (Fig. 137.) Make or repair a sizing machine, if possible. Practice grading and

packing apples and pears by different methods until you have developed skill in both operations. Keep a record of the causes of culled fruit. Assist in planning and erecting an apple store-house.

Kinds of Containers.—Early summer apples are often sent to market in bushel baskets with splint covers. The bushel box is used quite extensively in many sections. The barrel formerly used for later varieties in many sections is now rarely used. The bushel box seems to be the form of container that is gaining in favor. In many states the containers must be stamped or labeled with the variety name of the fruit, and the grade.

Grades of Apples.—Fruit should be graded before it is marketed. The U. S. Department of Agriculture has prepared grades for apples setting up requirements for U. S. Fancy, U. S. No. 1, U. S. Commercial, U. S. No. 1 Early, U. S. Utility, U. S. Utility Early, and U. S. Hail Grade. In addition, these standards provide for combinations of the above grades as follows: Combination U. S. Fancy and U. S. No. 1, Combination No. 1 and U. S. Utility, Combination U. S. No. 1 and U. S. Commercial. Apples which are not graded in conformity with any of the foregoing grades may be marked "Unclassified."

The requirements for the grades listed above are based upon freedom from blemish, maturity, and color. The requirements for U. S. Fancy, U. S. No. 1, and U. S. Commercial are the same except for color. In the case of winesap, for example, fifty per cent of the apple's surface must be red if marked Fancy, and twenty-five per cent if U. S. No. 1, but no color is required in the U. S. Commercial grade. Size is not a grade requirement, but the minimum size or the size range should be marked on the package along with the grade.

The Packing House.—The size of the packing house depends upon the amount of fruit to be graded and packed. The house should be located where it is easily accessible from the orchard. If possible, it should be near the main highway or railroad track so that hauling of packed fruit is not difficult.

The equipment needed for the packing house depends on whether boxes or barrels (Fig. 139) are to be used for containers.

Packing the Fruit.—The kinds of packs in boxes depend upon the sizes of the fruit. The packs used for boxes are sim-

ilar to those suggested for peaches in baskets. The apples for boxes are carefully wrapped in a good grade of tissue paper before they are packed. Be certain that the top layer is slightly above the box so that a bulge will be made when the top is nailed on. This holds the fruit tight. See description of box packing of fruit in the Citrus Enterprise.

Kinds of Storage Houses.—Apples may be stored in regular cold storage houses, which usually give the best results. In many cases, however, cold storage houses are not available.

FIG. 138

FIG. 139

FIG. 138.—A class lesson in expert grading and packing of apples. (U. S. D. A.)
FIG. 139.—Making apple barrels. (N. C. Div. of Markets.)

The main things to remember in constructing a house for storing apples is that it must be properly insulated from cold, and must be well ventilated. The insulation is secured by using double walls and making a dead-air chamber between the walls. The ventilation is regulated by placing ventilators in the floor and in the top of the house. These ventilators can be opened or closed to admit as much air as desired, to regulate the humidity, and to control the temperature.

Operating the House.—It is hard to exactly regulate the temperature in most storage houses. The temperature should be kept at 30 to 40 degrees F. whenever possible.

If the weather is warm, open the ventilators for several nights prior to the time the fruit is to be stored and close them early in the morning. Cool the fruit as much as possible before putting it into the storage house. In very cold weather

some warmth may be admitted by having glass windows open to sun in bright days and closed the remainder of the time.

Fruit for Storage.—Be careful to prevent bruising the fruit which is to be stored. Fruit should be carefully sorted to remove any having decayed spots. Pears and apples should not be entirely ripe when stored.

Job 15. Marketing Fruit

Conditions Usually Found.—Fruit is often sent to the wrong market or put on the market at the wrong time. Systematic marketing is practiced chiefly by large commercial growers.

Aims.—The different methods of marketing apples and pears, and the conditions under which each method is best should be known.

Problems for Study and Discussion

1. What are the advantages of coöperative marketing of fruit?
2. What preparation for marketing should be made in advance?
3. Compare shipping with local selling of fruit for your region.
4. To what markets could these fruits be hauled in trucks?
5. How are apples and pears marketed in your locality?
6. Where can you secure market reports?
7. Compare marketing of summer and winter varieties.
8. Describe the making and selling of cider and vinegar.
9. What other uses are made of the culls?
10. Enumerate the kinds of work of the market man.
11. Discuss using a roadside market for these fruits and other products.

Activities.—Assist in loading cars with apple boxes and barrels. Bill out shipments. Erect a roadside market place.

Marketing Fruit.—The variety to be marketed depends upon where to sell because certain varieties sell well on one market and not on another. The grower may sell to the local market or he may ship to the distant market. He may truck his fruit to a market not too far away. The bulk of the fruit crop is usually sold in some distant market by consigning the shipments to commission men or by selling through a coöperative association. In intensive fruit regions buyers often pay cash for the crop at the loading point, thus relieving the grower of risk in market changes.

Coöperative Selling.—As a rule, there are many advantages in selling fruit through a coöperative association. Among them these may be mentioned: (1) Markets may be found better where a large quantity of fruit is to be marketed. (2) Cars may be loaded rapidly together (Fig. 140). (3) Grading and packing

may be done at less cost per box. (4) Storage can be done better and cheaper. (5) Containers and supplies can be bought cheaper. (6) Money for harvesting can be secured at a lower rate of interest.

Using Cull Fruit.—Apples and pears not fit for market may be used for drying, for canning, for making sweet cider, for making cider vinegar, or for making fruit butters and jellies. Sweet cider is likely to sell well in local markets, and at roadside markets.

Job 16. Keeping Records

Special records should be kept for the orchard enterprise, such as those suggested in the Peach Enterprise. Regular forms,

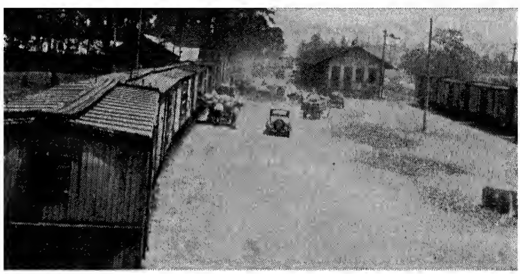


FIG. 140.—Coöperative loading of cars in North Carolina. (N. C. Div. of Markets.)

such as may be obtained by writing to your state station, or those given in the Melon Enterprise, may be used for the main financial records.

A trial set of forms should be filled by each student as preliminary practice. For this purpose data may be obtained from good orchardists.

Apple and Pear Calculations.—1. From the tables in Job 1 calculate percentages which production in your state for apples and pears are of the totals for the United States; apples 62,550,000 bushels and pears 25,249,000 bushels.

2. Calculate the number of trees needed in each case for planting an acre if set by these distances each way: 16½ feet, 20 feet, 30 feet, 33 feet, 40 feet. See rule in Appendix planting table.

3. If apple trees are set 40 feet apart each way, and peach trees are set in the rows each way at 20-foot intervals, how many trees of each kind are required for each acre? What fraction of the trees are apples?

4. A young man was able to grow 1,000 one-year-old apple trees at a total cost of 3½ cents each. If the roots and other materials cost $10, how much did he allow for land and labor? What per cent of the total cost was this?

5. A young man wanting only 270 trees to plant 10 acres was able to buy them at $15 per hundred. If he obtained them at that rate from the young man referred to in problem 4, how much would the grower make on the transaction, allowing nothing for digging, shipping, freight, etc.?

6. Two young men compared results on two apple orchards of the same variety, age, and on similar soil. One had grass sod in the orchard, and the other clean culture. Apples in the sod orchard required 434 per barrel, selling at $2.00. From the tilled orchard 309 apples filled a barrel, selling at $4.30. Allow 40 cents for each container and find the profit and per cent of profit due to size of the fruit.

7. In the cases referred to in problem 6 the yields per tree were 2.8 barrels of apples in the sod orchard and 4.2 barrels in the tilled orchard. Find the total yield in each ten-acre orchard if there were 40 trees per acre.

8. When the costs of tillage, etc., were counted, the profits per acre were $71.52 for the sod orchard and $110.93 for the tilled orchard. Find the gain and the percentage of gain due to tillage.

9. An experiment station found that the yields of marketable apples was increased by fertilizing: ½ acre of fertilized trees yielded 46 barrels; ½ acre not fertilized yielded 9 barrels. The fertilizer and labor cost $12 for the half acre. The apples sold for $2.00 per barrel over the cost of containers and labor. Find the profits due to fertilizing.

CITRUS ENTERPRISES

Collaborators: G. W. Adriance, Ph.D., Professor of Horticulture, College Station, Tex.; and George W. Dansby, M.A., Teacher of Vocational Agriculture, Alachua, Fla.

Citrus fruits, the orange, grapefruit, and lemon in particular, are the most important of the subtropical fruits grown commercially in the United States. The range of these fruits is limited by temperature requirements, since all are rather tender. The Satsuma orange tree is reported to be the hardiest, able to withstand temperatures as low as 18° F. when in a dormant condition. The lime is the most tender, subject to injury at a temperature of 28° F., according to the U. S. Department of Agriculture. In a thoroughly dormant condition, lemon trees are reported to be able to withstand temperatures down to 26° to 27°; orange and grapefruit, 23° to 24°; and tangerine, 22° to 23° F. The fruits, however, are injured at temperatures ranging from 27° to 30°, depending upon conditions and stage of development.

Analysis into Jobs.—The managerial and operative jobs which make up the unit operations in Citrus Enterprises are included in the following list.

Job 1. Determining Possibilities with Citrus Growing

Conditions Usually Found.—Citrus fruit is grown in restricted areas. If cared for properly, growers usually make a profit. Financing the enterprise is the most difficult problem.

Aims.—Growers should decide whether or not to grow citrus fruit. They should understand the factors involved in the cost of production, and should realize the hazards of the industry.

Problems for Study and Discussion

1. What states produce citrus fruits?
2. Compare the production of last year with that of ten years ago.
3. Name the leading counties in your state in the production of oranges, of grapefruit, and of tangerines.
4. What is the bearing and non-bearing acreage of citrus fruits in your state?
5. What yields may be expected on a five-year-old grove?
6. What are some of the factors which cause groves to be a failure?

7. What is the average price to expect for citrus fruit?
8. What is the cost of fencing a twenty-acre grove?
9. How much will the trees cost for such a grove?
10. What is the total cost per acre of a citrus grove until it reaches bearing age?
11. How much of the capital should the grower own and how could he borrow the rest?
12. What are the main marketing problems of your community or state?
13. How could you secure some knowledge of the citrus industry before you start your project?
14. What equipment would be needed for taking care of a grove and crop?

Activities.—Make pamphlet holders and shelves for home and school use. Send for all U. S. Dept. of Agr. bulletins, Farmers' bulletins, and State bulletins on citrus fruits.

Where Citrus Fruits are Grown.—The area for the production of citrus fruits is limited to the extreme southern part of

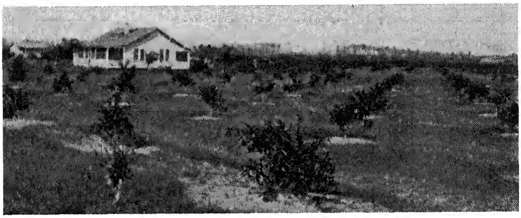


FIG. 141.—Young citrus grove showing thrifty growth. (Fla. State Dept. Agr.)

the United States. Citrus fruits are grown in California, Florida, Texas, Arizona, and Alabama. The Isle of Pines and Porto Rico produce grapefruit principally.

Recent information on the acreage or number of citrus trees in Florida, Texas, and Alabama is lacking. It is known, however, that a considerable increase in acreage has occurred, especially in Florida and Texas. (Fig. 141.) The leading counties in Florida for producing citrus fruits are as follows: Polk, Orange, Lake, Hillsborough, Volusia, Brevard, Highlands, Marion, Pinellas, Hardee, and DeSoto.

According to the California Crop and Livestock Reporting Service, there were, in 1944, in California 244,755 acres of oranges, 68,583 acres of lemons, 15,280 acres of grapefruit, and 783 acres of limes.

Yields.—Most growers expect a young grove to produce a profitable crop the fifth year and thereafter. Yields vary according to the age of the grove and the treatment, and kind and variety of fruit.

Costs per Acre.—Like any other kind of fruit, the cost of bringing an acre of citrus trees to bearing age varies from one section to another. It varies according to the price of the land, the cost of the trees, the amount of fertilizer used, spray materials used, and the cost of labor.

According to an estimate given by the Florida Department of Agriculture, the cost per acre for a grove during the first five years amounted to $331. The cost would probably range from $250 to $400 per acre for the first five years. After the first five years the grove should produce more than enough fruit to pay the expenses. Intercrops may pay most of the expenses during the first five years.

Prices.—For citrus fruits prices vary with the season and with the amount produced. The following table shows the average auction prices per box for Florida and California citrus fruits on the New York market:

U. S. Citrus: Weighted average price per box on the New York Auction

Season	Florida Grapefruit	Florida Oranges	California Navels	California Valencia
1939–40	$2.21	$2.43	$2.84	$3.39
1940–41	1.97	2.38	3.10	3.86
1941–42	2.55	2.87	3.14	4.77
1942–43	3.16	3.82	4.72	5.46
1943–44	3.67	3.96	4.73	5.67
1944–45	4.37	4.60	5.04	4.65

From these prices the freight, commission, packing house charges, and the cost of production must be deducted in order to get the net profit to the grower. A grower may expect to receive from $1.00 to $1.50 per box as an "on-the-tree" price for oranges.

Other Factors to Consider.—One of the main hazards of the citrus industry has been freezes. (Fig. 142.) Hurricanes and drouths may also cause serious damage. The freezes which have caused considerable damage in Florida occurred in 1835, 1836, 1894, and 1895. Several freezes which have caused heavy

losses of fruit without serious damage to the trees have occurred from time to time both in Florida and in California.

Job 2. Determining the Variety to Grow

Conditions Usually Found.—Many different varieties of citrus fruits are grown, and in many places too little regard is given to the proper selection of suitable varieties.

Aims.—Growers should know the advantages of each variety, and should be able to decide which varieties are best.

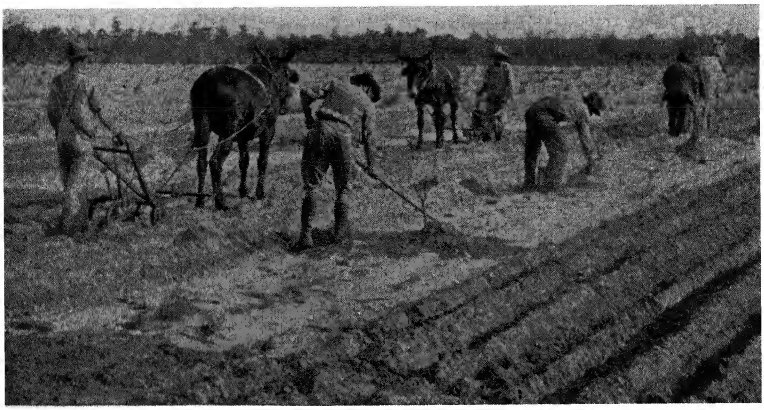


FIG. 142.—Winter protection of young citrus trees requires much labor where practiced. Mounds of soil are placed around trees in fall and spread, as shown, in spring. Clean cultivation is shown here.

Problems for Study and Discussion

1. Make a list of the leading varieties of oranges, of grapefruits, of tangerines, of satsumas, and of lemons.
2. Which of these varieties are early? Which late?
3. In what locality is each variety grown?
4. What varieties are the most popular in Florida? In California? In Texas?
5. What climatic conditions may determine the variety to grow?
6. Why has California only two main varieties of oranges?
7. What effect does the market price have on the variety of citrus grown?

Activities.—Study variety characteristics from market specimens and by visiting orchards. Hold contests in identifying varieties.

Varieties.—There is a tendency toward the adoption of fewer varieties of each kind of citrus fruit. The late and the early varieties are being chosen. Different varieties are adapted to the different climatic conditions. The following are standard varieties of citrus fruits (Figs. 143, 144, and 145).

FIG. 143.—Oranges as they grow on trees. (Lakeland Chamber of Commerce.)

FIG. 144.—Clusters of grapefruit on the tree. (Seaboard A. L. Ry.)

Oranges—Parson Brown, Hamlin, Pineapple, Valencia, and Navel.
Grapefruit—Marsh Seedless, Duncan, Foster, Pink Marsh or Thompson, and Ruby.
Tangerines—Dancy.
Satsumas—Owari, Ikeda, and Aairai.

California's most popular varieties of oranges are the Washington Navel and the Valencia.

In Florida, the most popular varieties of oranges are Hamlin, Parson Brown, Pineapple, and Valencia. The most popular varieties of grapefruit are Marsh Seedless, Duncan, and pink varieties.

FIG. 145.—Tangerines as they grow on the tree.

The kid-glove oranges are Dancy Tangerine, Mandarin, King Orange, Owari Satsuma, and Temple.

Job 3. Choosing Soils and Sites for Citrus Fruits

Conditions Usually Found.—The growing of citrus fruits is a specialized industry and does not do equally well on all types of soil or under all climatic conditions.

Aims.—Growers should know the kinds of soil best suited for citrus fruit and the best location on the farm for a grove.

Problems for Study and Discussion

1. How many commercial groves are in your community?
2. What packing-house facilities are found in your section?

3. Name three types of soil suitable for citrus growing.
4. What are the advantages of well-drained soil?
5. Why should a grove be located on a slope? Which exposure is best?
6. What temperatures will kill citrus trees?
7. What price can you afford to pay for citrus land?
8. How may a grove be protected from frost and cold?

Soils.—Citrus trees will grow on high pine land, on flatwoods soil, on hammock soil, and on muck soil. Any soils in the true citrus belt that are fertile, well drained, and free from clay will grow citrus fruits. Citrus trees grow best on naturally productive soils. Hammock soil is preferable to light sandy pine land. The hammock soil usually has a natural growth of magnolia, oak, ash, or "cabbage" palmetto trees. The best grade of high pine land has a natural growth of long-leaf pine, and the light sandy pine land a growth of "old field" pines, "scrub" oaks, and small red oaks.

Sites.—If the grove can be located near a packing house the cost of hauling the fruit will be decreased. Where possible, the grove site should be near a lake or a large body of water in order to protect against frost. The soil for citrus fruit should be well elevated and preferably on the southern slope of a hill.

Buying Land.—The price of land ranges from a very low price to a higher price than can be warranted for the culture of citrus. Normally good citrus land can be bought at a relatively low price, but during the war years prices increased. Probably the average citrus land can be bought for $15 to $50 per acre where there is no irrigation, but it is much higher under irrigation, as in Texas and California.

A sandy loam soil, well drained and elevated, naturally fertile, and located near a body of water and near a packing house is the kind of land to buy for citrus groves.

Protecting from Cold.—The two main ways of protecting citrus groves from cold damage are by locating on high elevations and by locating near bodies of water. The large, fresh-water lakes of Florida give a certain amount of protection from cold. Air drainage is important in preventing frosts, because of air currents produced. Growers learn from experience not to plant citrus fruits in a valley.

In many localities some protection must be given the trees during extremely cold weather. This may be done by burning

piles of wood or litter in the grove between the trees. Oil pots or orchard heaters, which may be purchased, are also used. By the use of these heaters or the open fires the temperature may be raised from 2 to 5 degrees F.; air currents are set up which tend to prevent frost. Clouds of smoke may also have their beneficial effects.

Job 4. Selecting, Cutting, and Storing Budwood

Conditions Usually Found.—Some nurserymen use budwood or scions from other trees in the nursery rather than from bearing, pedigreed trees. More attention needs to be given to the selection of budwood.

Aims.—How to select, cut, and store budwood, how to sterilize packing material, and how to pack budwood should be understood.

Problems for Study and Discussion

1. When should budwood be cut for storing?
2. Why would you use budwood from producing trees?
3. Why are records of production kept for the best trees in the grove?
4. What season's growth of wood should you use for budwood? Why?
5. Describe the characteristics of good citrus bud sticks.
6. What are blind buds?
7. What materials are used for storing the budwood? Describe storage.
8. How should this material be disinfected?
9. Why should the material be moist?

Activities.—Study trees and bud variations, as to yields, quality of fruit, and annual bearing. Select and store a quantity of bud sticks.

Kinds of Buds to Select.—Buds should be selected from bearing trees which produce desirable fruit in large quantities, as budded trees will be like the parent trees in this respect. Records of production from the very best trees should be kept at harvest time. The trees may be pruned for the production of budwood. Only strong, green, well-filled-out buds should be selected. Select only the growth of the past summer.

Cutting and Storing Bud Sticks.—Budwood may be cut in the fall when the trees are dormant, stored in a moist, cool place in sawdust or sand, and used in the spring; or it may be cut and used immediately either in the fall or in the spring. The bud sticks are cut about ten or twelve inches long, and bear fifteen to twenty eyes or buds.

Blind buds are often found on bud sticks. These buds are small, depressed buds, which are not found on all trees. When used for budding they may fail to develop, although they may stay green for a long time.

Job 5. Propagating and Buying Citrus Trees

Conditions Usually Found.—When only a few trees are needed, it is cheaper to buy them than to grow them. It takes a great deal of care to propagate trees. Budding methods are most common.

Aims.—How to propagate citrus trees, and how to care for a nursery and choose good trees should be understood.

Problems for Study and Discussion

1. What are the requirements for a good nursery site?
2. How should the soil be prepared for the nursery?
3. What root stocks are used for budding citrus trees?
4. How would you plant the seed for a nursery?
5. What cultivation and care does the nursery need?
6. What varieties would you propagate?
7. How and when would you select budwood?
8. How would you bud citrus trees?
9. Describe the waxing of budding tape or cotton.
10. How do you care for the buds after they have been inserted?
11. How do you stake and prune the budded tree after it begins to grow?
12. Give directions for preparing, digging, and balling trees.
13. Suggest methods of buying trees. Give costs.

Activities.—Students should bud trees until skill is gained. From the rule in the Appendix, calculate the number of trees needed to set an acre.

Propagating Citrus Trees.—Citrus fruits may be easily propagated by budding, by grafting, by seeds, or by layering. A few kinds will grow from cuttings. Budding is the common method used by practically all nurserymen. The shield bud or inverted ⊥ is used. This cut is made on the stock just above the ground. The bud is then inserted and slipped up the perpendicular cut. Budding is usually done in the spring. After twelve or fourteen days the buds are unwrapped and allowed to grow. The plants are staked, and as the buds grow they are tied to the stake.

Stocks for Citrus Trees.—The different stocks used for citrus fruit are sour orange, sweet orange, rough lemon, pomelo, trifoliate orange, and Cleopatra orange. These different stocks are adapted to different soils and climatic conditions.

The trifoliate orange stock is the hardiest of all the different stocks used. It does not thrive very well on high, dry soils. This stock is used almost entirely for satsuma oranges.

The sour orange stock ranks next to the trifoliate orange in hardiness. It develops a good root system and is used for stocks for oranges, for grapefruits, and for tangerines.

The rough lemon stock is easily damaged by cold and is seldom used.

The sweet orange stock is not so hardy as the sour orange and is also subject to foot-rot. For these reasons it is little used.

The pomelo stock is a vigorous grower but is not so hardy as sour orange. It is used in a few places instead of the sour orange stock.

The Cleopatra orange stock is just being tried and little data can be given as to its merits. Some nurserymen claim that it is superior to the sour orange as a stock.

Planting the Nursery.—Locate the nursery on a hillside with a southern exposure and, if possible, near a body of water. Medium loams or sandy loams induce a good formation of roots. The soil should be heavy enough to cling to the roots to form balls when trees are dug. The land should have all stumps, roots, and trash removed, and should then be broken deep with a large turning plow.

The sour oranges are usually purchased and the seed extracted for planting. It should be planted in thin rows in seed-beds. The seedlings are transplanted from the seed-bed to the nursery rows when they are about six inches high, and are set from eight to twelve inches apart in the rows. After growing one or two years in nursery rows, the seedling stocks are budded.

Caring for the Nursery.—Cultivation should be given often enough to keep down all weeds and grass. Applications of fertilizer should be given to cause the proper growth. Special care should be taken to keep all insects and diseases under control. The nurseryman must meet all requirements of the state plant board or other inspection authorities. Sour orange seedlings in the nursery will probably need to be sprayed with Bordeaux mixture for scab diseases.

Buying Citrus Trees.—Visit a nursery and inspect trees before ordering. Buy from old, well-established nurseries, and avoid "bargain-priced" trees sold by peddlers or unknown salesmen. The trees selected should be straight, uniform, of green wood, and free from cuts and bruises. The trees should also be free from insect or disease damage, and have a straight taproot with deep, long, fibrous feeder roots.

The cost of trees varies according to the size and quality as well as according to supply and demand. Prices range from 25

cents to $1 per tree, with the average price for good trees being about 75 cents in Florida, and somewhat more in Texas unless purchased in large quantities.

Keeping Names True.—Careful nurserymen keep correct records of the rows where each variety or strain of buds is grown. If these become mixed, much trouble may follow. When trees are dug they are carefully labeled and tied in bundles for shipment.

Preparing Trees for Digging.—Trees should be pruned before being dug. There are two general methods in use: one method in which a part of the forked branch of the young tree

FIG. 146.—Citrus trees in the nursery ready for digging.

is left attached; and the other method in which the tree is headed back to about thirty inches in height. The trees are often defoliated before being dug, to reduce the evaporation. Digging is usually done in late fall or winter. Trees may be heeled-in and held for shipment later.

Digging the Trees.—A regular nursery spade is used in digging the trees from the nursery. This spade has a short handle and a long, heavy sharp blade. The blade of the spade is forced down into the soil about twelve inches away from the tree. The soil is then removed to a depth of about eighteen inches by digging at right angle to the first cut. The taproot is cut with the point of the spade as it is forced under the plant, and the plant is lifted with the spade and by pulling on the tree. A man should be able to dig from 250 to 300 trees per day by using this method. Special care must be taken to prevent injury to the trees and to keep the sun from drying out the roots. Most trees

in Texas and California are dug with a ball of earth about the roots. (Figs. 146 and 147.)

Packing the Trees.—Regulations in some states require that the trees be washed with oil emulsion before they are packed. In packing, all parts of the tree must be completely covered to prevent any infestation in transit. A certificate of inspection must be attached to the package. If the trees are to enter other states, in some cases other regulations may be necessary. Trees

Fig. 147.—Vocational students of Pearsall, Tex., learning to ball the roots of citrus trees for shipment. (M. W. Carlton, Agr'l Teacher.)

may be shipped in crates or in burlap bags. Probably the latter method is usually followed.

Job 6. Preparing the Orchard Site and Planting Trees

Conditions Usually Found.—Grove owners usually take pride in laying out their groves and in preparing soil well; but in many cases the trees are poorly set.

Aims.—Growers should know how to prepare the site; lay off rows; dig holes; set trees; and care for trees after setting.

Problems for Study and Discussion

1. Describe good soil preparation for an orchard.
2. What methods are used in laying off groves?
3. How far apart should the trees be set?
4. When is the best time to set trees?
5. How should the holes be dug for the trees?
6. How much water should be used per tree?
7. Discuss depth for setting citrus trees.
8. How should a tree be set?
9. How should trees be cared for after setting?

Activities.—Practice laying off a grove, and assist in setting trees.

Preparing Site.—The soil for a grove should be plowed very deep, as the roots of the trees are deep feeders. The surface should be disked or harrowed one or more times. If the surface is rough, a plank drag may be used before marking off the rows. Some growers plow furrows for the rows as another means of mellowing the soil at planting time.

Laying Off Groves.—Groves are usually surveyed and the stakes set by the use of a surveyor's chain. The usual distances for setting standard trees are 25 x 25, 25 x 30, and 30 x 30 feet. Kumquats are usually set 15 x 15 feet. The grove is usually staked off for the trees in squares. Both the rectangular and the triangular methods are occasionally used. The stakes serve as markers and also provide holes large enough and deep enough to admit the taproot of the tree when it is set.

Holes for the trees should be dug circular and V-shaped around the stake. It is necessary to dig holes deep enough to receive only the feeder roots, as the taproot is placed in the hole occupied by the stake.

Setting Citrus Trees.—After the taproot of the tree is placed in the hole occupied by the stake, the soil is tramped around it, and the feeding roots are spread out evenly. The tree should be set about one inch higher than it was in the nursery, so that after it has settled, it will stand at the same depth as it was in the nursery. The soil is placed in the hole until it is completely filled. When the tree is set, it is best to make a circular rim around the top of the soil and fill it with five or ten gallons of water. In order to get the trees exactly in line, it is well to use a planting board. (Fig. 148.)

Job 7. Cultivating the Citrus Grove

Conditions Usually Found.—There is no set system of cultivation. Some growers advocate thorough cultivation, while others do not cultivate their groves at all.

Aims.—The reasons for cultivating citrus groves and the different systems used by experienced growers should be well understood.

Problems for Study and Discussion

1. What are the functions of cultivation?
2. What systems of cultivation are used in your locality?
3. What are the objections to not cultivating citrus groves at all?
4. What implements are used in cultivating citrus groves?
5. What intercropping would be most profitable and least injurious to citrus groves?
6. How would you plan to renovate an old neglected grove?

Cultivating the Grove.—Practically all grove owners agree that the soil should be prepared before the young trees are set. The methods of plowing and cultivation differ according to the type of soil, the cover crops used, and the age of the trees. The best culture methods should be followed, but these must be determined by the grower himself for his particular site. The best growers recommend one plowing per year for bearing

FIG. 148.—Planting citrus trees by use of a planting board so that the locations will be accurate. (Fla. State Dept. Agr.)

groves. Green manure grown as a cover crop is turned under at this plowing in early spring. The later cultivations for that year are done with a disk harrow. Other growers cultivate entirely with disk or cutaway harrows, using no turning plows. (Fig. 149.) Some hoeing around each tree is necessary. Cultivation in non-irrigated regions can be stopped when the rainy season begins. A cover crop is then planted.

Intercropping.—Young orchards are often cropped during the first five years with money crops such as truck, berries, and others. The cultivation of such temporary money crops should be planned so as to stimulate the growth of the citrus trees.

Renovation.—Old groves often need renovating, particularly if they have been neglected by absentee owners or others. The main steps in renovation are shallow plowing or disking, intelli-

gent pruning, and fertilizing. It is sometimes necessary to reset some trees.

Job 8. Providing Plant Food; Applying Fertilizers

Conditions Usually Found.—(1) Growers buy fertilizers by brand rather than by formula and seldom buy separate materials. (2) Applications are often too light and not well suited to the grove. (3) Too many fail to grow and use green manure crops.

Aims.—The best plant foods and fertilizer formulas to use for citrus trees, rates and times of application, and what green manure crops are best to use, should be understood. Also, how to buy materials economically should be understood.

FIG. 149.—Large citrus grove showing clean cultivation after plowing under a green manure crop.

Problems for Study and Discussion

1. Find the ton prices and car-lot prices for mixed fertilizers and for separate ingredients.
2. Make a list of the different sources of nitrogen, of potash, and of phosphoric acid.
3. Compare cash prices with credit prices.
4. What is the action of the various fertilizer ingredients—nitrogen, phosphoric acid, and potash—on citrus trees and fruits?
5. What plant foods are usually lacking in citrus soils of your state?
6. Calculate the saving which would result from the home-mixing of fertilizer.
7. What spray materials would you buy and have on hand for your grove?
8. What fertilizers would you use for the spring application on young trees? For the fall application?

9. What fertilizers would you use for a bearing grove in the spring? In the fall?
10. Why reduce the nitrogen in the fall and increase it in the spring application?
11. How much fertilizer is needed for a young grove? For a bearing grove? Give basis of calculation.
12. What effect does a heavy application of phosphorus in the summer have on the maturity of the fruit?
13. What cover crops or green manure crops would you recommend for the citrus grove?
14. Explain the effects of organic and inorganic fertilizer materials.

When to Fertilize.—Most growers give the grove three applications of fertilizer and a few use four applications. The usual practice is to make a heavy application in the early spring, using a rather high amount of nitrogen content from inorganic materials. The summer application is made before the heavy rains commence, and the last application is made late in the fall. At this application the amount of nitrogen is reduced very low and the amount of potash material increased.

Spring Applications.—A formula used by many growers for the early spring application is 4-8-4 or 3-8-5 (N-P-K). This is applied before the spring bloom. During the summer the rains may leach out soluble fertilizer materials; and to prevent this many growers use organic nitrogen in the spring or summer applications. If a green manure crop is plowed under each year nitrogen may be omitted, and less leaching will occur.

The fall applications of fertilizer require very little nitrogen. A formula containing the following should prove sufficient for this application: 1 or 2 per cent nitrogen, 6 to 8 per cent phosphoric acid, and 6 to 8 per cent potash. Such a composition on a fertilizer tag may be summarized as 1-6-6 or 2-8-8 (N-P-K).

Amounts of Fertilizer.—As a general rule, the amount per young tree is one pound for each year the tree is old at each application. For example, a three-year-old tree should receive three pounds of fertilizer at each application. About four pounds of fertilizer per bearing tree is needed to produce a box of fruit, and about four more pounds to keep the tree in a good, healthy, growing condition. Some growers go by this rule in fertilizing their groves. A tree capable of producing four boxes of fruit should receive thirty-two pounds of fertilizer for the year, or about eleven pounds at each application.

Crops for Green Manure.—It is very essential that organic matter be added to citrus orchard soils; and the most practical way is by the growth of crops turned under as green manure. The grower has his choice of using velvet beans, cowpeas (Fig. 150), beggarweed, crotalaria and others from the legume group, and a number of different grains (Fig. 151), grasses, and weeds.

Job 9. Controlling Diseases and Insects

Conditions Usually Found.—Diseases and insects cause great losses to citrus growers from the loss of trees, poor quality of fruit, and from the expense involved in spraying. Many growers do not know how to prepare spray materials.

Aims.—Growers should be able to identify the different citrus diseases and insects and know what methods of control to use; and should be able to prepare and apply the different spray materials.

Problems for Study and Discussion

1. What is meant by prevention of a disease?
2. Name, identify, and describe the most serious citrus diseases.
3. What others are less serious?
4. Give directions for preparing Bordeaux mixture.
5. What diseases of citrus orchards are prevented by spraying with Bordeaux mixture?
6. What diseases are controlled by pruning?
7. What diseases are controlled by cutting out the diseased wood?
8. What materials are used as paint for control of citrus diseases?
9. What control methods should be used for each of the following diseases: withertip, dieback, anthracnose, gummosis, blight, foot-rot, and melanose?
10. What are the most serious citrus insects?
11. How are these insects controlled?
12. Suggest a spray schedule for the control of citrus diseases and insects.

Activities.—Study citrus diseases and insects, their effects and control measures. Collect and preserve specimens.

Citrus Diseases.—Some of the factors that may have some influence directly or indirectly on disease control are listed: the grove location, the soil type, the moisture supply, the vitality of the trees, the cultural methods used, the use of fertilizers, resistance of trees or the kind of citrus stocks used, the temperature, and mechanical injury from cultivation, winds, or rodents.

Spraying the grove with a fungicide has its limitations and is not followed as a general practice. Chief among the reasons for not using a fungicide applied to the trees is that it may destroy beneficial insects. However, sometimes spraying with Bordeaux

FIG. 150.—Catch crops of cowpeas produce good green manure for citrus groves.

FIG. 151.—In bearing citrus groves, managers often desire a soil cover of oats or similar growth.

mixture becomes a necessity and should be applied before diseases gain much headway. The sprays should be applied in the form of fine mist in order to give uniform distribution. This requires a high pressure of 180 to 200 pounds. The formula may be 3-3-50, 4-4-50, or the 5-5-50, depending upon the age of the foliage.

Pruning is a method of control for certain citrus diseases. The usual time for pruning is in December or January. However, some pruning may be done in June or July.

Withertip is common and attacks the twigs and branches, which wither and die. Numerous dead terminal twigs, barren and discolored branches, and the yellowing and shedding of leaves, dropping of fruit, and a general run-down, stunted, and sickly appearance of the tree are symptoms of this disease. The same fungus also causes *anthracnose* and *tear stain*. These diseases are controlled by proper pruning methods. (See U. S. D. A. Bul. 924D.)

Foot-rot is another citrus disease ot importance. It attacks the crowns and main roots of citrus trees. All trees budded on sour orange stocks are immune to this disease, while most others are susceptible. The injury caused by the fungus begins in the bark of the crowns or main roots of the trees at or just below the surface of the ground. The trees ooze gum and their bark appears water-soaked. From these areas the injury may extend entirely around the trunks.

To prevent the disease use resistant stocks. Where the disease is active, the diseased area should be cut out down to clean, healthy wood, and the wounds painted with antiseptics, as corrosive sublimate (bichloride of mercury) or avenarius carbolineum.

Gummosis occurs mainly on the trunks and larger branches of the trees. There are two types of this disease. In one type the bark scales up and the gum oozes out of the exposed areas and hardens. In the second type the diseased area is found on all parts of the tree above the ground, even on the twigs. The cause of this disease is not known. It is recommended that all dead and diseased bark down to the live tissue be removed and then the cuts painted with strong antiseptics.

Citrus Blight.—The cause and cure for citrus blight is not known. A withering of the tree, as if it were suffering from a drouth, is first noticed. The tree puts out a number of water sprouts which soon die. The tree may bloom heavily but continue to die.

Dieback has five symptoms which are usually found: gum pockets, stained terminal branches, ammoniated fruits, bark excretions, and extra terminal buds. The cause of the disease is unknown. Control methods require the starving of the trees of nitrogen, and reducing the cultivation.

Melanose is one of the most common diseases of citrus trees, affecting the foliage, young twigs, and branches. The injury to the fruit, twigs, and leaves occurs in the form of small, circular hard spots with glazed surfaces, which are raised above the healthy tissue. The fungus causing the disease lives and multiplies in dead twigs and branches. The same fungus causes *stem-end rot* of citrus fruit.

To control the disease, keep down insects, keep the trees in a healthy, growing condition by proper fertilization and cultivation, and prune the

trees carefully and regularly. Spraying with Bordeaux mixture may also help to prevent melanose.

Other citrus diseases are citrus scab (see U. S. D. A. Bul. 1118D.), citrus knot, leaf spot, and sooty mold. They are controlled by following the spray schedule as suggested.

Citrus Insect Control.—The most injurious citrus insects are the ones which suck the plant juices. The entomogenous fungi, predacious insects of many kinds, and internal parasites play a big part in their control. They may be controlled also by means of certain contact sprays such as oil-and-soap emulsion, tobacco extract, and lime-sulfur.

Insects Listed.—The damage done to citrus groves by insects is larger than that caused by diseases. There are six insects that cause the greatest damage to citrus fruit. They are common white fly, purple scale, rust mite, Florida red scale, cloudy-winged white fly, and aphids.

Other insects of less importance are red spiders, thrips, woolly white fly, mealy bugs, cottony cushion scale, snow scale, orange dog, chaff scale, pumpkin bugs, termites, and ants. For details see U. S. Farmers' Bulletins 933 and 1321.

Job 10. Harvesting Citrus Fruits

Conditions Usually Found.—Picking crews usually work by contract at a specified price per box. In many cases these workers injure the trees in their hurry to pick as many boxes as possible.

Aims.—Students should know the stages of maturity at which to pick citrus fruits; how to protect trees in picking; and how to pick fruit from the trees.

Problems for Study and Discussion

1. What are the maturity dates for the different varieties of citrus fruits?
2. What determines the stage of ripeness for picking the different types of citrus fruit?
3. What is the effect on prices and demand for citrus fruit resulting from placing green fruit on the market?
4. What are the regulations regarding the shipment of green fruit?
5. What equipment is needed for picking citrus fruits?
6. How do the growers near you get fruit picked?
7. What prices per box are paid for picking fruit?
8. How is the fruit handled after picking before it is packed?

Activities.—Practice picking and caring for citrus fruits. Make special ladders, lugs, and truck frames to suit this job.

Skills in Picking.—The manipulative processes or skills involved in this job are obtaining equipment for picking the fruit,

clipping fruit from the tree, using ladders, and handling the fruit after picking.

Ripeness or maturity of citrus fruit is determined by the sugar content as well as by the color. When shipped before December 1 in Florida it is necessary to have the fruit inspected and tested for ripeness and a certificate issued. Ripeness can also be determined by the season of the year at which the variety or varieties usually mature. For example, in Florida Parson Brown oranges ripen about October 20; the Pineapple, December 10; the Valencia, March 10; and the Washington Navel, October 20. Dates for grapefruit: Triumph, November 1; Duncan, December 20; McCarthy, February 1; and Walters, November 10. The Dancy tangerine ripens from November 25 to December 25. Satsumas mature in the latter part of October.

Picking Operations.—All fruit is clipped from the tree with a pair of clippers, somewhat resembling a pair of scissors. Different types of clippers are used, preference being given to short clippers with blunt points. Regulation picking bags are usually used. Light ladders are used by the pickers to get fruit from tall trees. Care must be taken in using the ladder to prevent injury to the branches. Care and judgment should be exercised not to injure the trees. Picking is usually done by a crew of men under packing-house supervision, and is paid for at a specified price per box. Regulation field boxes are used for hauling the fruit to the packing house. (Fig. 152.)

Job 11. Grading and Packing Citrus Fruits

Conditions Usually Found.—This job is usually directed by packing associations or companies.

Aims.—How citrus fruit is washed, graded, sized, polished, packed, labeled, and loaded should be well known.

Problems for Study and Discussion

1. How is citrus fruit washed at the packing house?
2. How is citrus fruit polished?
3. What are the grades of oranges? Of grapefruit? Of tangerines? Of satsumas?
4. How is the fruit sized?
5. What are the arrangements of the fruit in the crate as to size?
6. What are the qualifications for No. 1 brights? For goldens? For russets?
7. Describe wrappers and the work of wrapping.
8. How are the crates packed in the car for shipment?
9. What should be the size and construction of a packing house?

FIG. 152.—Picking grapefruit, using picking sacks, field crates, and ladders.

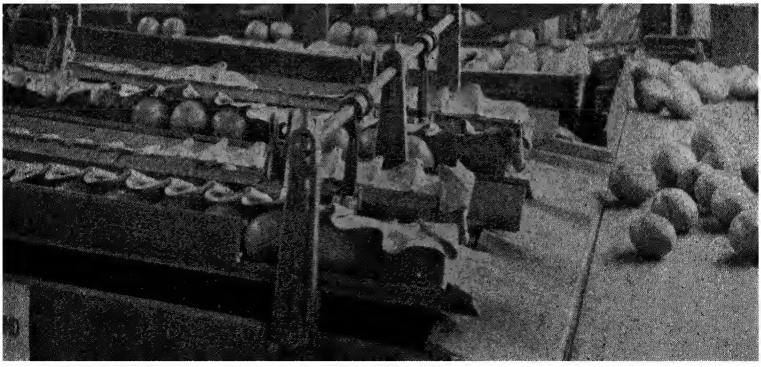


FIG. 153.—Mechanical polishing of grapefruit after washing, before packing.

Activities.—Practice grading and packing fruit. Compete with others in these operations. Make or repair grading equipment. Make packing boxes from flat stock.

Grading Fruit.—Before any grading is done at the packing house the fruit is washed, dried, and polished. The actual grading is done by hand as the fruit passes along the grading belt. All injured, blemished, and misshapen fruits of any kind are discarded. Good fruits are sorted after polishing (Fig. 153) into three grades: Brights, goldens, and russets. Vegetable

FIG. 154.—Mechanical sizing and hand grading of citrus fruit, after washing and drying, before packing.

coloring matter is often used to give each fruit a uniform golden color.

After being graded, the fruit passes over the sizing machine, which separates it into the various sizes. The most popular sizes vary from 150 to 176 oranges per box and from 54 to 80 grapefruits per box. (Fig. 154.)

Packing Fruit.—All of the kid-glove oranges are packed in half boxes or "straps," the number of fruit in a box ranging from 48 to 246. Oranges are packed in boxes 12 x 12 x 24 inches, and the bulged pack is used.

The fruits are wrapped in tissue paper and packed according to size in the crates (Fig. 155). Some of the common packs for oranges follow: the 3-3, in four, five, or six layers; the 4-3, in four, five, or six layers; the 3-2, in five layers; the 4-4, in five

layers; the 5-4, in five layers. For grapefruit the following packs are the common ones in use: the 1-2, in three layers; the 2-2, in three or four layers; the 2-3, in three or four layers; and the 3-3, in three or four layers. In the arrangement for the mandarin and other kid-glove varieties the packs are practically the same as for corresponding sizes of grapefruits and oranges.

Loading for Shipment.—Crates are loaded into cars for shipment just after they are packed. The usual method of loading is to place the crates on end, two stacks high, six rows wide, and

FIG. 155.—Wrapping and packing citrus fruit in crates for shipment to markets.

usually thirty boxes long. The boxes are spaced for ventilation and stripped to prevent shifting in the car. Cars usually hold 360 to 432 boxes, with 300 as the minimum. Oranges usually weigh about 80 pounds per box. Grapefruit is loaded similarly to oranges.

Tangerines are loaded in cars with half boxes or straps on end, twelve straps wide, two straps high, thirty straps long, giving approximately 720 straps to the car.

The cars are sometimes iced at the point of origin and also in transit. There is a movement on foot to have the railroads establish pre-cooling stations so that fruit may be pre-cooled before it is shipped and re-cooled in transit if necessary.

Job 12. Marketing Citrus Fruit

Conditions Usually Found.—Many growers try to market fruit before it is ripe. Too many different marketing agencies handle the citrus crop. The flow of fruit to market is often poorly controlled.

Aims.—The importance of prohibiting the marketing of green fruit, the advantages of coöperative marketing, and the factors which influence the proper distribution of citrus fruits, should be well understood.

Problems for Study and Discussion

1. When does the marketing of citrus fruit begin?
2. What varieties usually mature earliest?
3. What factors determine quality in citrus fruits?
4. What effect does green fruit have on the market?
5. Explain the operations of the green fruit law.
6. Show the application of the law of supply and demand to citrus fruit prices.
7. What facilities for marketing citrus fruit are in your community?
8. How does production affect marketing?
9. What is the average price or cost per box for handling fruit from the tree to the loaded car?
10. What are the costs per box for selling citrus fruits?
11. How low may the price of fruit go before a grower cannot afford to harvest and sell?
12. What has been the average sale price per box for the past five years?
13. What improvements are needed in methods of marketing citrus fruits?
14. Explain the organization and the operation of the citrus growers' clearing house association.

Production Affects Marketing.—In marketing citrus fruit we must not lose sight of the ever-present law of supply and demand. In years of low production favorable prices are received and in years of high production the problem of marketing the fruit at favorable prices becomes serious.

The marketing of citrus fruits begins with production. The buying public wants these fruits to have good appearance, good quality, and good flavor. Fruit marketed when the smallest amount of fruit is available generally brings the best price. See monthly price tables. Usually the early and the late varieties bring the best prices. One of the greatest difficulties in the Florida citrus industry has been the regulation and control of the quality of fruit put on the market in the early season.

High Quality Counts.—The problem of better prices is generally a problem of better quality, which means ripe, clean, well developed, and highly flavored fruit. Some of the factors which aid in helping to secure more net gain to the growers are the production of only quality fruit, lowering the cost of harvesting, packing, and selling, and a control of the distribution of fruit

to the market. See U. S. Agricultural Statistics for prices by months.

Marketing Steps.—Citrus fruits are marketed through citrus growers' associations and shippers. These organizations have their own packing houses and equipment, and they begin their operation of marketing with the fruit on the trees. They pick, haul to the packing house, wash, grade, pack, load, and sell the fruit for the growers.

The total cost of these operations varies in different sections and with different associations. It varies from 85 cents to $1.50 per packed box of fruit. These figures do not include the cost of selling, which amounts to 10 or 15 cents per box of fruit. The charges for the selling and for harvesting, packing, and marketing should be ascertained before a marketing agency is selected.

Selling on Trees.—Some growers sell their fruit on the trees to operators or brokers who do their own picking, hauling, grading, and packing. This system has its advantages as the risk of price fluctuation is shifted to the buyer; however, such buyers usually offer low prices.

Job 13. Keeping Records

Citrus Enterprise Records.—These should be kept on such forms as are shown in the Melon Enterprises or on other suitable forms. Read the suggestions for special orchard records given in the Peach Enterprise.

Activities.—Students should secure data from citrus growers and fill out a set of forms for practice before a new year's set of records is started.

Citrus Calculations.—1. A student had a piece of land for a citrus grove, in the shape of a circle, the radius of which was 15 rods. What was the area in acres?

2. How many orange trees are needed for an acre if the trees are set 25 x 25 feet?

3. How many pounds of fertilizer will be needed per acre if six pounds are applied per tree in problem 2?

4. A bearing grove was "fired" two nights to prevent frosting, at the cost of $8 per acre each night. If the grove produced 40 extra boxes per acre of fruit valued at $2.25 net per box, what percentage of profit was made on the "firing"?

5. If a bearing grove is worth \$500 per acre and costs \$125 annually to maintain, what must the fruit bring in order for the grower to make a 10% profit, after paying 8% on his investment?

6. A grower needs 5 tons of fertilizer for his grove, which can be purchased for \$40 per ton cash or \$46 per ton on six months' time. A bank will loan money at 8%. Which plan would pay better, and how much?

Coöperative Marketing

Brings better price
Maintains high standards
Opens better markets
Stimulates better production
Interests more growers
Lowers shipping costs
Reduces overhead expense
Fosters community spirit
Functions for middlemen
Uses government inspection

PECAN ENTERPRISES

Collaborator: J. G. Woodroof, Ph.D., Formerly Professor of Horticulture, Georgia Experiment Station; and C. L. Isbell, Ph.D., Department of Horticulture, Auburn, Ala.

The pecan is a native of the southern part of the United States and northern Mexico. It is not grown commercially outside of the United States. Because it does not need so much winter cold as most deciduous fruits such as apples and peaches to break the dormancy of the buds, it can be grown in warmer climates. However, a long, hot growing season is needed to mature the nut; thus its production is limited largely to the southern states.

About one-third of the commercial production of pecans is from cultivated plantings of selected varieties, while the remaining two-thirds is gathered from seedling trees growing naturally along the streams and in overflow land.

Analysis into Jobs.—The list below includes the main managerial and operative jobs in the Pecan Enterprises.

Job 1. Determining Possibilities with Pecans

Conditions Usually Found.—Pecans are found growing about many farm homes in pecan-growing states. The plantings vary from a few trees in the home yard to extensive commercial groves. Many of the older plantings and larger trees are of seedling origin and many are more or less unprofitable.

Aims.—The following as related to pecan growing should be understood: (1) climate; (2) labor requirements and distribution; (3) probable cost of a grove; (4) age of bearing trees; (5) when to expect returns; and (6) amount of returns.

Problems for Study and Discussion

1. What are the climatic requirements of the pecan?
2. What soil produces the best and most economical crops of pecans in your section?
3. What cropping season is best with pecans?
4. In what job do pecans require the most labor?
5. What is the cost per acre of bringing a grove into bearing?

6. How does this compare in different sections?
7. What are the ages for early bearing? For profitable bearing?
8. In what markets could the crop be sold with profit?
9. What yields per tree may be expected each year?

Climatic Requirements.—The native home of the pecan is undoubtedly in the flatlands and adjacent areas of the southeastern quarter of the United States and as far west as the hundredth meridian in southern Texas. The northern limit of production is south of the 39th degree of latitude, or about that of Vincennes, Ind. For commercial purposes, pecans seem to coincide with cotton in climatic requirements. The pecan is not well adapted to commercial planting in southern Florida and similar regions, nor to the extreme weather conditions in the states north of Oklahoma. To produce the better commercial varieties, eight to nine months of growing weather are needed. Such conditions are found mainly in central South Carolina, Georgia, Alabama, Mississippi, Louisiana, east Texas, and in northern Florida; or, generally speaking, within the southern belt of cotton farming along the Gulf coast and the Atlantic seaboard, and in certain irrigated valleys in Arizona.

Probable Costs.—The variable factors which influence the cost of establishing an orchard are: (1) land cost; (2) size of planting; (3) size and quality of trees; (4) number of trees per acre; (5) soil fertility; and (6) labor cost. The cost of establishing and bringing a grove into full bearing, as reported by some of the best growers, is between four and five hundred dollars per acre.

Production studies by J. D. Pope, Alabama Station, show that the cost of production on an eighteen-year-old planting of forty-six acres (twelve trees per acre), including labor and current expenses, but excluding land rent and harvesting, was as follows:

Year	*Per Pound*	*Production in lbs.*
1924	.11¼	7,808
1925	.07¼	18,285
1926	.08	14,019
1927	.11¼	7,600

It will be seen from this study that the production cost decreases as the yields increase.

When Trees Begin Bearing.—Under ideal conditions, a budded or grafted tree may be expected to produce a small crop

about the fifth or sixth year after planting. The grower may expect fair returns about the eighth year, but as a general rule the pecan varieties will not produce heavy crops until the tenth year.

Yields.—In Georgia, carefully kept records of one 14-year-old orchard of 20 acres would indicate that over a period of the last seven years the average yield of nuts per tree has been about $10\frac{1}{4}$ pounds. Another 15-year-old orchard over a ten-year period averaged 12.41 pounds per tree. Yields are very variable, however, and there have been reports of older trees bearing as high as 700 to 1,000 pounds of nuts in one year.

Prices.—The 1945 U. S. Department of Agriculture statistics indicate that the average price of improved pecans during 1945 was 29.4 cents per pound. The average price of seedlings was 20 cents per pound, or a general average of 24.1 cents per pound.

Job 2. Selecting Soil and Site

Conditions Usually Found.—Commercial plantings of pecans are often located by real estate men and selection of the site and soil has been given too little consideration. Groves of bearing age are often found to be giving poor returns, partly because of improper selection of the site and soil.

Aims.—Good sites and proper soils, and the influence of topography and drainage should be understood.

Problems for Study and Discussion

1. Report opinions of best growers as to what factors are necessary in selecting sites and soils.
2. Which is more important, site or soil? Why?
3. Determine the depth of water table for pecan growing in your section.
4. After what preceding crops do growers in your section prefer to plant pecans?
5. On what soils in your region do trees grow most rapidly, largest, and produce best crops?
6. Discuss planting pecans along highways.

Activities.—Locate one or more grove sites, planted or unplanted.

Upland vs. Bottom Land.—The trees are more thrifty on drained bottom land than on upland. A fairly level, well-drained, fertile upland or lowland area where hickories and pecans grow naturally should suit pecan orchards. Trees may be more thrifty on river bottoms but it has not often been found that they are more productive. Some of the best producing orchards are the more elevated or approaching hill land. In western dry regions, river bottom land is commonly preferred.

The land for pecans should not be of such a hilly nature as to wash badly, nor so flat as not to drain. The trees demand much fertility and a deep top soil, which is almost impossible to find and maintain on extremely hilly land. On the other hand, a very low, wet soil may have the water table too near the surface. Low or bottom land might be so wet at harvest time, because of surrounding conditions, as to be a serious handicap. Also, some low lands may be "crawfish" soils, which crack open badly when dry. These are factors which make successful commercial growing almost impossible. The low lands are to be preferred to high "washed-out" hillsides, but either extreme is unfavorable. Gently rolling land is generally accepted as ideal. The trees blossom late in spring, and the crop is seldom, if ever, killed by late frost.

Soil Adaptation.—The most ideal soil is one high in organic content which will be able to retain moisture; one with a reasonably low water level; one with a deep loamy top soil and a deep sandy-clay subsoil, and of a fairly rich nature. Porous sandy soils, soils which have clay or hard-pan subsoils, and low, wet lands should not be planted to pecans. Plant food may be supplied if the soil is otherwise favorable. This is done by turning under green manure crops and by the application of barnyard manure or commercial fertilizer. A grower should select soil having the desired mechanical structure, and then increase the organic content himself by economical methods.

The Type of Soil.—For successful pecan growing recommendations differ slightly with the different states. The sandy loams and clay loams of the Orangeburg series and Ruston probably represent the best types of soils for successful groves. The sandy loams and medium loams of the Norfolk, Tifton and Greenville series are frequently used with satisfactory results. The Norfolk and similar light soils necessitate the use of heavier and more frequent applications of fertilizer and barnyard manures; otherwise weak and rosetted trees may be the result. Usually, soil which will not grow good cotton or corn is not suitable for pecan trees.

Crops Preceding Pecans.—If soils are rather light, a heavy crop of velvet beans, cowpeas or clover should precede the setting of pecans. Fields should be chosen which have been cleared

for some years and have been in use for corn, cotton or other cultivated crops in rotation with legumes.

A good plan is to grow such crops as will keep the ground covered during the summer. For example, corn or melons may be planted during early summer, with cowpeas sown at last cultivation for disking under in the fall, and this may be followed by a winter cover crop of rye or oats with some winter vetch.

Job 3. Choosing Varieties

Conditions Usually Found.—The agricultural extension specialists and local agricultural workers usually supply information leading to the selection of the variety or varieties best suited to a given section. Varieties of known value in a given section may be almost worthless in another section.

Aims.—The best varieties for commercial planting and home planting should be understood.

Problems for Study and Discussion

1. What are the characteristics of a good commercial variety?
2. Of what importance is thinness of shell?
3. Discuss the importance of size and uniformity of nut.
4. Prepare a list of varieties grown in your section and find from growers the merits of each variety.
5. Prepare a list of varieties for home use.
6. What variety or varieties bring highest prices in market?
7. Which varieties bear young?
8. Which varieties are least affected by disease?
9. What varieties are recommended by your state experiment station?

Activities.—Collect nuts of the leading varieties. Cure these and place in glass fruit jars with proper labels. Use catalogs of nurseries, station bulletins, and specimens, and make a table of the characteristics of all the pecan varieties described.

Factors to Consider.—Resistance to disease, regular bearing, heavy yielding, quality, popular market demand, and adaptability to soil should be factors considered in selecting a variety.

Determining the Variety.—Selection should be backed by experiment station recommendations and be of known value in the section, or in a section having similar soil and climatic conditions as that in which the planting is contemplated. Pecans are long-lived trees and require ten or more years to come into profitable bearing, so a grower must plant varieties of known value. Opinions change regarding the best varieties for a locality. In such cases several varieties may be selected.

The price factor must not be taken alone as the deciding point. For example, the Schley demands the best market price, because of quality; but it is highly subject to scab when grown in some sections, with the result of little or no profit. It is usually not a heavy bearer, except under better than the average conditions.

Some varieties do better on heavy soils, high in organic content. The Stuart, for example, is an outstanding variety in the Orangeburg district of South Carolina. The continual growing of a variety in a locality indicates its success there.

FIG. 156.—Pecan of the Success variety in a poultry yard. They are eleven years old and have been bearing seven years.

Outstanding varieties generally include Schley, Stuart, Moneymaker, Curtis, Success, Brooks, Moore, and Mahan, listed for the southern and southeastern states. However, this entire list of varieties will not do equally well in all sections. The varieties demanding the highest prices are Schley, Stuart, and Success (Fig. 156). These varieties should shell out about 50 per cent meats. The Mahan is a new and promising variety. The nuts are probably the largest of any one variety. It is recommended that the student get in touch with the experiment station in his particular state to secure a list of recommended varieties adapted to local conditions. A recommended list will also be found in Farmers' Bulletin 700, U. S. Department of Agriculture.

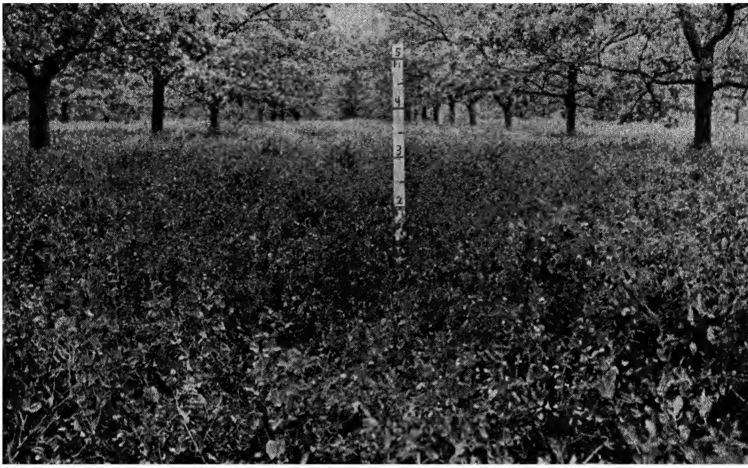


FIG. 156a.—Austrian winter peas is a good winter cover crop for pecan orchards. (Courtesy of the Florida Agricultural Experiment Station.)

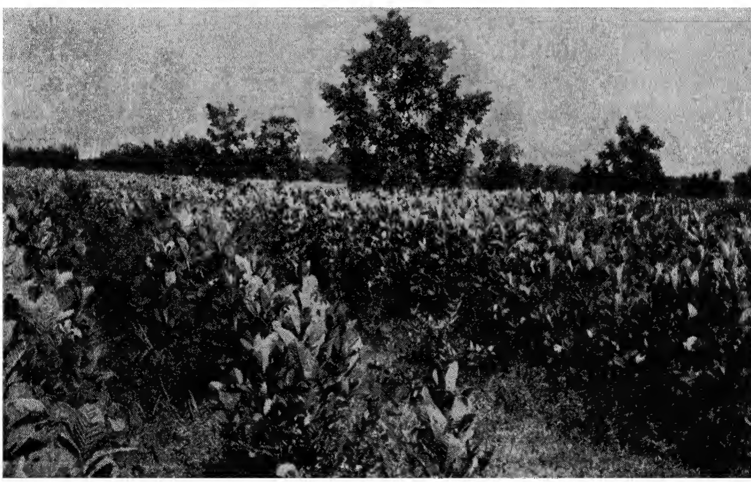


FIG. 156b.—Crotalaria Spectabilis growing in a young pecan orchard. This is an excellent summer cover crop, though not adaptable to feeding livestock.

Job 4. Buying Trees; Propagating; Top-working

Conditions Usually Found.—Reliable nurserymen are selected on the recommendation of fellow growers or agricultural extension workers. The fruit tree agent, selling by a picture book, was the source of trees for many old plantings, some of which were unsatisfactory. Experienced growers often propagate or top-work their own trees successfully.

Aims.—Good source of nursery stock; best methods of propagating pecans; and the conditions and methods of top-working should be known.

Problems for Study and Discussion

1. What are the sources of the nursery stock used in your section?
2. List the local nurserymen in your community or a few you know in your state.
3. Determine the best source or sources of good pecan trees.
4. What difficulties does the grower face in buying trees from the average nursery-stock salesman?
5. What size, age, and kind of trees should be selected?
6. What should be the cost of good pecan trees?
7. What growers in your region produce their own trees?
8. Describe the steps in propagating pecans. (Farmers' Bulletin 700.)
9. Compare grafting and budding for pecans. Give steps.
10. Under what conditions would you recommend top-working? Give steps.

Activities.—Visit nurseries or examine shipments of trees just received. Heel them in. Practice propagating pecan trees by budding and by grafting.

Local Nurseries.—Trees should be bought from nurserymen who know the needs of your region. Several advantages are gained by buying from a local nursery: (1) Trees of known quality may be seen and selected in the nursery. (2) The reliability of the nurserymen is more easily determined. (3) Trees can usually be handled and transported with less exposure and less expense. (4) Varieties are more likely to be adapted to the section. (5) A constant source of good trees is encouraged.

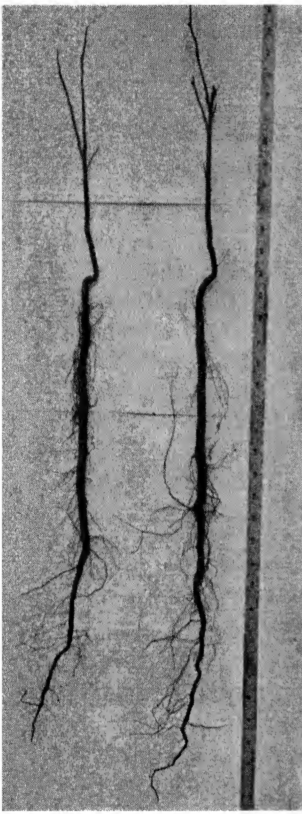
The local nursery may be able to give better prices than others, but should not be condemned if prices are a little higher than those of an unknown nursery.

The reliability of a nursery should always be fully determined before an order is given. Representatives of state colleges and departments of agriculture can aid in this. Where large orders are being placed, a visit to the nursery for the purpose of inspecting the trees and nursery conditions is well justified. If the nursery cannot be visited, ordering tree samples of the size and quality quoted is a good plan.

Sizes and Ages of Trees.—Growers differ widely regarding the sizes and ages of trees to be planted. All agree that the trees must be vigorous and well grown and should be sufficiently low to permit correct and proper branching or heading.

A one-year-old budded or grafted tree which has made a growth of three to five feet from the bud or graft during one year, and which has a vigorous root system, is to be desired. Larger

FIG. 157 FIG. 158



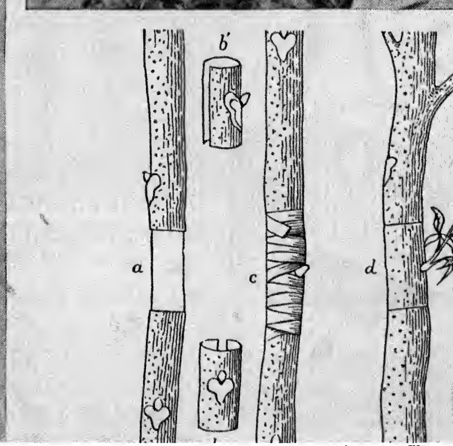


FIG. 157.—Seedling pecans showing root systems of two-year-old plants. Tops ready for budding. The Mexican pecan stocks have a more branched, fibrous root system. (S. C. Exp. Sta.)

FIG. 158.—Vocational student budding pecans by the annular method, late in the season.

FIG. 159.—Successive steps in budding by the annular method: *a*, the bud stick after removal of the bud; *b*, *b′*, front and side views of the bud; *c*, the bud in place on the stock after being wrapped with a half-inch strip of waxed cloth; *d*, the bud starting into growth after the cloth has been removed. (After U. S. D. A.)

and older trees are more expensive, do not stand the shock of transplanting as well as small trees, and the transportation cost is higher.

Buying Trees.—Poor trees often have to be dug up and replaced with better trees. When buying trees, select only those which have made a thrifty growth in the nursery row, measuring three to five feet in height, having good diameter and good, strong, fine roots.

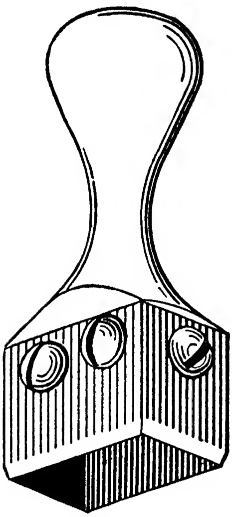


FIG. 160.—A metal tool specially designed for use in patch budding of pecans. (After U. S. D. A.)

Propagating Pecans.—Some growers may desire to grow their own trees. Bulletin 191 of the Florida Station will aid in this. Nuts should be stratified in well-drained locations in the fall of the year. They should be placed in alternate layers and covered with sand two inches thick, the final layer being given a covering of several inches. After two or three months they are ready for planting in rows three to four feet apart to allow cultivation. They should be planted about six inches apart. If shells are thin, stratification is sometimes omitted and the nuts are planted in rows before the middle of December. Cultivate the rows of seedlings to make thrifty growth for one season. (Fig. 157.)

Budding.—There are three methods generally used for budding pecans: (1) annular ring (Figs. 158 and 159); (2) patch (Fig. 160); and (3) chip. Annular ring and patch budding are most commonly used. Annular ring budding is common for budding late in the season and in the top-working of large trees. Chip budding is less used than is either patch or annular ring budding. The season for chip budding is during early spring (about the time buds break and the sap begins to flow) and may be continued until the first leaves are about half-grown. Chip budding is valuable in extending the propagating season, by partially filling in between the seasons for summer budding and winter grafting.

Crown budding, as a fourth method, was developed by C. L. Edwards, of Dallas, Tex. (See U. S. Farmers' Bulletin 1501.)

This is a modification of shield and chip budding and can be used to advantage when other methods are less satisfactory, because of the condition of the stock.

Grafting has not been used as commonly as budding but is becoming more popular. Cleft and bark grafting are used for top-working. The three kinds of grafting are (1) cleft grafting and (2) bark grafting for working over of large trees; and (3) tongue grafting for nursery propagation.

Top-working; Cutting Back Trees.—Budding or grafting may be used in the top-working of undesirable varieties or seedling trees.

FIG. 161.—Vocational students at Runge, Tex., top-working pecan trees; E. D. Parnell, teacher.

To be top-worked, trees should be cut back during early spring and before growth begins (Fig. 161). The limbs should be cut so as to thin out, have the new top reasonably low, and so as to preserve the rounding shape of the tree. Branches or limbs should be carefully selected, and the well-placed branches cut back a distance of from twelve to twenty-four inches from the body of the tree. Care must also be taken to have the top rounded and to have several "feed-limbs" or sap-circulating limbs left about the tree. All cuts should be smooth, and should be painted with a good lead paint or pruning compound.

BUYING VS. GROWING PECAN TREES FOR THE GROVE

Buying

1. Saves several years' time.
2. Saves losses from poor work.
3. Saves land rent and nursery labor.
4. Saves buying seed and materials.
5. May result in better trees.

Growing

1. Certain of variety.
2. Local strains known.
3. Saves cash outlay for trees.
4. Avoids nursery disappointments.
5. Gives knowledge of nursery methods.

Job 5. Laying Out the Grove; Preparing the Soil

Conditions Usually Found.—(1) Plantings of modern commercial growers are usually well planned. (2) Early plantings, usually of seedling origin, are too closely and irregularly spaced. (3) Commercial groves are planted on well-prepared soils, but exceptions to this are too common.

Aims.—The best methods of laying out groves, and of preparing soils for planting should be well understood.

Problems for Study and Discussion

1. Compare phases of grove planting in your section.
2. What are the best spacing distances for trees?
3. What variations from this do you find in your section?
4. Describe the steps in staking out a grove.
5. Describe practices followed in preparing soil for pecan planting in your section.
6. Determine the cost per acre of preparing soil for pecan planting.
7. Compare good and poor practices found in soil preparation in your section.
8. Describe the steps in soil preparation for pecans under each of the following soil conditions: (a) cotton field; (b) grain stubble field; (c) field planted the preceding summer to cowpeas; (d) field planted to a winter cover crop; (e) newly cleared timber land.

Activities.—Make a chart showing three plans of laying out an area for planting. Stake out an area by each of three methods.

Methods.—The best growers of experience anticipate the planting and begin preparing the soil during the spring and summer before setting the following fall and winter. The soil should be plowed as deeply as necessary to incorporate thoroughly and completely all vegetative material. Sufficient time between plowing and tree planting must be given to permit the decay of the organic matter. The soil should be harrowed or disked several times. If the soil is sod, cutting deep in two directions with a disk harrow makes the plowing more satisfactory.

When grove planting follows clean cultivated crops such as cotton, potatoes, and truck crops, less preparation is necessary and disking or double disking may suffice. If the soil be in sod, grain stubble, or some broadcast crop, the surface soil should be plowed under.

In case of a growing cover crop when the trees are being planted, strip plowing to a width of six or more feet in the tree rows is a common and good practice. The planting need not disturb the balance of the cover crop. The strip may be well prepared. The balance of the cover crop may be disked in or plowed under at a later date.

FIG. 162.—The need of allowing plenty of distance between trees is shown. Half-grown trees are mingling their branches with their trunks forty-five feet apart. Small grain is sown in early fall to serve as a cover crop and green manure. (Seaboard A. L. Ry.)

Transplanting Distances.—The distances between trees vary slightly with the soil fertility, variety, and lay of the ground. Rich soils permit wider spacing because the trees grow broader and larger. Some varieties tend to grow tall and narrow and can be planted closer. If the area is very rolling, it may not accommodate as many trees as a level area, because of terraces and waste corners necessary in preventing soil washing. Planting distances on rather level area should not be closer than forty-five fieet on light soils; and may be seventy to eighty feet on better pecan soil. (Fig. 162.) On rich alluvial soils of the

San Marcos Valley, distances are often one hundred feet.

Laying out the Grove.—Trees should be carefully aligned and uniformly spaced by the most practical method. There are two systems commonly used in laying out groves: the square and the contour. The square system is most generally used and is to be desired.

The contour system of planting is used to best advantage where the surface is sloping enough to need terracing. Where the slope is rather uniform a level line may be staked along the central belt line. Then other lines may run parallel to this, both above and below. If the slope is great enough, there may be a terrace for each row of trees and the trees may be planted to follow the terrace lines. The annual plowing of the soil may be toward the lower row until the terrace is sufficiently high.

Job 6. Setting Pecan Trees

Conditions Usually Found.—Trees are usually planted in late fall or winter. Both the roots and tops are frequently pruned. Many trees are carefully set on poorly prepared soil, and do not thrive.

Aims.—The value of proper setting and the most approved practices should be understood.

Problems for Study and Discussion

1. What pruning is required at the time of setting? Why is this done then?
2. Explain good methods of digging holes for setting trees.
3. Compare different methods: by dynamite, by plowing, by shovel and post-hole digger.
4. Discuss size and depth of holes.
5. When is the best time for preparing tree holes?
6. Describe the use of a tree planting board.
7. Give the details of the planting of a tree.
8. What is the advantage of a good moisture supply at the time of setting?

Activities.—Make a planting board. Practice digging holes and setting trees.

Tree Setting.—Careful consideration should be given to the following factors associated with tree setting: (1) pruning; (2) preparation of the hole; (3) distribution of trees; (4) actual setting of the trees.

Pruning.—Pruning at the time of transplanting should consist of cutting back the top and removing injured roots. Lateral branches are usually not numerous and are not to be desired on good one-year-old pecan trees. The tops should be cut back to about 24 to 30 inches from the ground. In case of older or

branched trees, broken branches should be cut out and others thinned and shortened back to stubs. Correct pruning at planting encourages quick and rapid growth with correct development of the tree (Fig. 163).

Preparation of the Hole.—The hole should allow plenty of room for the proper spread of roots at the time of planting.

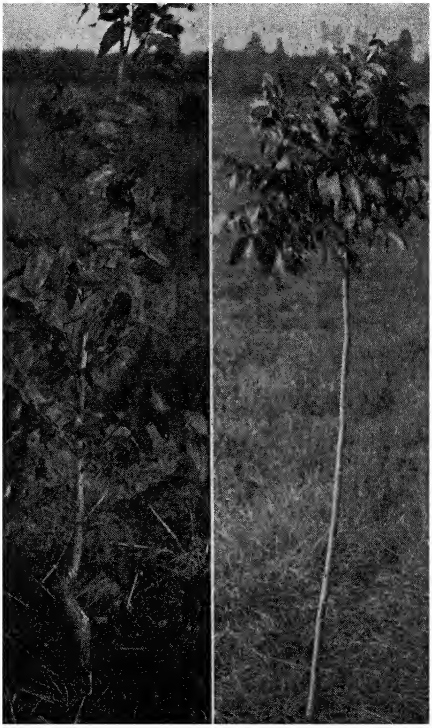


FIG. 163.—Pecan trees one season's growth from buds. Left, low-headed. Right, high-headed. (S. C. Exp. Sta.)

The depth should permit setting the tree about as deep as when in the nursery and allow for fresh top soil under the tree. Ample depth for the long tap root is very necessary; too deep setting is harmful. Fertile top soil should be thrown in the bottom of the hole.

Distribution of the Trees.—Barrels of water may be used in which to immerse the roots of trees before planting and from

which to distribute them in the field. Otherwise, keep roots carefully covered with wet burlap sacks until ready for planting, and distribute without exposure to wind or sunlight.

Actual Setting of Trees.—This requires much care and only dependable workmen should be employed in tree setting. Distribute trees from a water barrel or a wet sheet and do not expose the roots to the air and sunlight. One man should be in the hole holding the tree with one hand, preferably against the planting board, and spreading the roots horizontally with the other hand. A second man should shovel good soil into the hole, while the first man firms and packs it. The plant should be set at a depth one inch below the nursery depth. Setting much below nursery depth may mean slower growth, and setting much above nursery depth may mean loss of the tree. If planting is timed to follow fall rains, watering of trees should not be necessary. Plenty of moisture at planting time is important.

Transplanting.—For all practical purposes, from late November to early February is the best season for setting trees. December is probably the best planting month in the greater part of the pecan belt. Setting the trees in the winter allows them to become established, to gather moisture, and the soil to become permanently settled before growth should begin in the spring.

Job 7. Providing Plant Food; Applying Fertilizer

Conditions Usually Found.—The kinds and amounts of fertilizer vary greatly. Successful growers follow recommendations of experiment stations.

Aims.—The best fertilizing practices to suit soils, farming practices, and other conditions should be understood.

Problems for Study and Discussion

1. What fertilizers are recommended by your state experiment station for your immediate section?
2. How should the use of commercial fertilizers differ for young trees and bearing trees?
3. State what changes are needed in fertilizing if plenty of green manure is used.
4. How much fertilizer is required per tree?
5. Compare rates on light and on heavy soils.
6. Compare formulas for different soils.
7. Upon what does the number of applications of fertilizer depend?
8. How many applications of fertilizer are made and at what times?

Manures.—Green manure crops should be plowed under or barnyard manure should be used before and after planting orchards on uplands. These forms of plant food help the growth of young trees and aid in maintaining permanent fertility.

Fertilizers.—On many upland soils, nitrogen should be the main fertilizer during the first five years or until the trees begin bearing. This may be applied in the form of nitrate of soda, sulfate of ammonia, or similar quickly available materials, unless the soil is very low in organic matter; in that case, use some nitrogen from organic sources or turn under green manure.

After the trees begin bearing, a complete fertilizer should be applied annually with the practice of a regular annual cover-cropping program. Experiments clearly show that liberal applications annually of a complete fertilizer and the use of green manure pay.

Amounts of Fertilizer.—The recommended amounts of fertilizer for the young trees during the first few years vary from three to fifteen pounds per tree, depending on age of trees and kind of soil. Older trees should be much larger and demand twenty pounds each or much more per year. An increase of two pounds per year may be advisable, depending somewhat on the soil and the yields.

Applications.—Where there are retentive subsoils, the season's amount of fertilizer may all be given at one time and well worked into the soil before growth begins each spring; but stations have not shown when to apply fertilizers. On porous soils of leaching qualities, fertilizer may be saved by applying half of the mixture just before the buds swell and the other half during the main growing period.

The feeding area of roots extends from the trunks to much beyond the spread of the branches. This serves as a guide to the application of fertilizers. With old trees, a lime spreader may be used in broadcasting fertilizers. This should be done well in advance of the time trees begin growth.

Most satisfactory fruiting seems to follow or be associated with plump, stocky, terminal growth of four to eight inches. This varies to some extent with varieties. To produce a large quantity of such fruiting wood, the tree should be making sufficient growth that numerous vegetative shoots one and a half to two

feet long may be seen well distributed over the top. Trees of low vitality developing weak terminal growths are not productive.

Job 8. Cultivating and Intercropping

Conditions Usually Found.—Shallow cultivation around the trees and companion intercropping between rows are generally followed by experienced growers. Many inexperienced growers cultivate too deeply and too closely to the trees. Groves are often cultivated so late as to cause winter injury because of sappy growth.

Aims.—The student should understand and practice the best and most approved methods of cultivation and intercropping.

Problems for Study and Discussion

1. What are the purposes of cultivation?
2. Outline a season's cultivation program.
3. What equipment is necessary for this?
4. When would you plow under the winter cover crop as green manure?
5. Calculate the annual cost of cultivation.
6. What are the advantages of intercropping?
7. List several good crops for this purpose in your section.
8. Why should cultivation cease by late summer?

Activities.—Examine and compare the root growths of pecan trees cultivated closely and deeply with those cultivated shallow during April and May. Examine the effects of late summer cultivation.

Purpose.—The main purposes of cultivation are soil maintenance, weed control, moisture control, and soil aëration. Many growers maintain a dust mulch about the trees throughout the summer. Others grow a leguminous summer crop covering the area, and others mulch the ground with litter. Experimental work indicates that very shallow cultivation, as with a disk harrow, should be kept up for control of weeds and grass. Such clean culture is recommended after the winter cover crop is plowed under or disked under, and is continued until late summer.

Tools and implements of common usage in general farming and orcharding are found valuable in the pecan grove. The disk harrow should be most regularly used.

The Season's Tillage Program.—A combination of shallow cultivation and the planting of annual cover crops is always beneficial. The soil should be completely broken by shallow plowing under or disking under the winter cover crop as green manure in very early spring. When intercrops are grown between the trees for the first six or eight years, there should be a strip near the trees kept in clean culture each growing season.

Cultivation may be zig-zagged about the trees. The cultivation of the rows of the intercrop is of benefit to the tree.

Intercropping.—Cash crops grown between the young pecan trees should be so profitable as to pay for the tillage of the grove during the first eight years. Crops used for this purpose are peanuts, cotton, watermelon, cantaloupe, and other truck crops. The crop grown should not interfere with the growing of a winter cover crop.

In bearing groves, after the use of intercrops has been discontinued, it is well to turn under the winter cover crops in early spring. Then the soil is kept disked or harrowed for six or eight weeks, when a summer crop of cowpeas or soybeans is sown. This is worked in as green manure about August first, and a winter cover crop of rye, vetch, and crimson clover is sown. Allowing grass to go to seed is not a good practice.

Job 9. Pruning Trees

Conditions Usually Found.—Pecan trees are pruned very little. Severe pruning is not recommended and is seldom practiced. (Heading back is sometimes well done at planting time.)

Aims.—The students should understand correct methods of pruning and should know when to prune.

Problems for Study and Discussion

1. Why are pecan trees pruned?
2. What equipment is required for this?
3. When is the pruning best done?
4. How should a tree be pruned at planting time?
5. Give directions for pruning young trees in a grove.
6. Explain methods of pruning bearing trees.

Tools.—For the newly set, or young, orchard only hand-pruning shears are needed. In older orchards, hand shears, poll pruners, saws, and lopping shears are needed. In rejuvenating work, the saw and lopping shears are much used. Tools must be sharp and in such condition as to make clean cuts.

The purposes of pruning pecans are to admit light to the buds, to maintain a balance in the tree, to eliminate broken and dead limbs, and also to prevent extreme height of trees. Pruning probably does not stimulate the tree growth to a noticeable extent. It seems to be generally understood that a pecan orchard will do well with but little pruning.

Time of Pruning.—The work of pruning is done mainly in the fall and winter when the leaves are off. Summer pruning of young trees is often necessary to develop the right branches with as little loss of plant food as possible.

Methods.—The trees should be started low, not over three feet high (Fig. 163). Pecan trees tend to grow tall and low heading tends to counteract this. Correct pruning during early growth tends to keep the trees lower. Spraying and harvesting can be more easily done. Low branches also tend to prevent the use of cultivating tools too close to the trees. During the first summer in the field all side branches should be allowed to remain so as to develop stockiness. The pruning may be somewhat like that for apples. Suckers at the base of the tree should be removed. Large wounds should be coated with white lead paint or pruning compounds. The prunings should be removed from the grove and burned.

Job 10. Controlling Enemies

Conditions Usually Found.—Growers of experience generally follow the recommendations given by experiment stations, and keep their groves in fair to good condition. NOTE: Keep in constant touch with state experiment stations and the U. S. D. A. for recommended changes.

Aims.—Growers should realize the need of spraying and dusting, and should know the uses of machines and materials available.

Problems for Study and Discussion

1. What are the chief diseases of pecans?
2. What insects may become serious in pecan groves?
3. Give two kinds of sprays with the formula for each.
4. What materials will be needed for spraying for the control of (a) chewing insects; (b) sucking insects; and (c) fungous disease?
5. When should spray and dust be applied?
6. Describe the use of dust versus spray.
7. Give directions for using spraying equipment.

Activities.—Collect specimens of disease and insects and their work on pecans. Practice fighting these enemies.

Special Equipment.—A high-pressure power sprayer or duster is needed to apply sprays and dusts to tall trees. Spraying is to be preferred over dusting. A ten-horse-power machine is none too powerful. An elevated mixing stand will help. An elevated tower on the spray wagon should be provided. This will make dusting and spraying easier and more thorough. Barrel pumps are suitable for small trees. (Fig. 164.)

Scab is probably the most common disease of pecans. It attacks the leaves, twigs, and nuts. Dark velvet-like specks or spots are seen. It is more serious during moist or wet periods. Scab is less serious in the less humid sections. Clean-up measures are recommended. Use resistant varieties and spray with Bordeaux mixture.

Brown leaf spot may start at any time when leaves are on the trees. Spores are scattered by the wind. Leaves show reddish, irregular spots which extend through the leaves. Spraying with Bordeaux mixture is recommended. Some varieties are more susceptible than others.

Rosette appears to be a zinc deficiency disease, and is shown by small, wrinkled, yellowish foliage growing in bunches, and by weak growth. Apply zinc sulphate as a spray or as a fertilizer.

Powdery mildew covers the leaves and nuts with a powdery coating, worse during rainy periods. Spray with Bordeaux.

Pecan leaf blotch follows weakened and thickly planted trees, attacks older foliage, and gradually defoliates the tree. Orchard sanitation and Bordeaux spraying or dusting will control effectively.

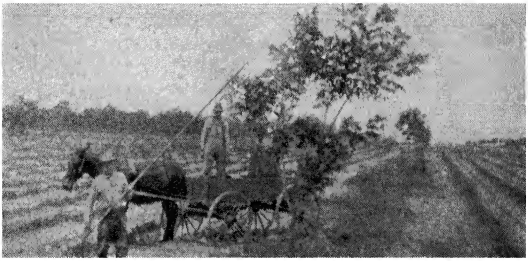


FIG. 164.—Pecan project, spraying for scab disease and insects, using arsenate of lead with Bordeaux mixture.

Girdlers.—The adult beetles lay eggs in young twigs and then cut off the twigs by girdling. This work is noticed from early fall to cold weather. Pick up and burn all the twigs and branches. As persimmon and hickory trees of the region act as hosts for these insects, the trouble may be reduced by destroying the cut off branches from such trees.

Cossid Borer.—This is also called the hickory or oak tree borer. In the larva stage the borers attack the trunks and larger limbs, and are noticed by the sawdust or reddish castings thrown from the holes. Clean out the holes and plug them with cotton saturated with carbon bisulfide. Then close holes with paraffin.

Stink Bug.—These familiar bugs sometimes attack soft green nuts, especially on the lower branches, causing black spots on the kernels, often called *kernel spot* disease. These bugs prefer cowpeas and related crops grown in the grove, and move to the trees when these host plants become tough or scarce. Use clean-up measures. Avoid growing crops which are host plants to the stink bug.

Fall Webworm.—These larvæ feed on the leaves of the trees and envelop the branches within a web. They may defoliate the entire tree. They may begin work as early as May.

Growers sometimes burn out the webs when first noticed. They may be cut out and destroyed. Spray the entire tree with calcium arsenate in Bordeaux, 1 pound to 50 gallons of Bordeaux.

Walnut Caterpillars.—In the larva stage these insects feed on young leaves and may defoliate the trees. They often appear in masses on the trunks of the trees. Crush these masses when seen, and spray trees as for fall webworms.

Flat-head Apple Tree Borer.—This insect, in the larva stage, bores through the bark and cuts irregular runs or galleries, and sometimes girdles the trees. Its presence may be detected by slightly discolored depressions on the bark. Watch for these from May to September. Remove them with a sharp knife. Paint the wounds with lead paint. Washing the trunks with lime-sulfur may keep away the insects. Keep trees in healthy condition.

Pecan Weevils.—The adult females puncture the tender husks and lay eggs in them. The young enter the nuts and after feeding until grown, leave through holes the size of a "BB" shot and enter the soil. Nuts should be fumigated with carbon bisulfide to kill any insects remaining in them. Clean culture and sanitary measures will aid in the control of weevils.

Shuck worms in the larva stage bore in the husks of mature and immature nuts. This often causes nuts to fail to mature, or to fall off before maturing. It causes discoloration of mature nuts. Cleaning up the husks at each harvest time and burning them will do much toward holding this enemy in check.

Obscure scale is often serious on pecan trees in Texas and the Gulf coast states. Use the winter spray of oil emulsion as described for other trees (apples, peaches, etc.).

Pecan Nut Case-bearer.—The worm stage of this insect attacks tender shoots and the newly set nuts when about the size of a "BB" shot. Usually, the worm bores in, at, or near the base of the nut, and the presence is indicated by web-tangled masses of frass. Later generations attack the larger nuts until the shells begin to harden. Spraying with arsenate of lead is recommended by some investigators, but control is questionable.

Pecan Leaf Case-bearer.—This is a very troublesome pest in pecan growing and is found throughout the pecan belt. It is reported (Farmers' Bulletin 1654) as being a very serious pest in Florida, southern parts of Georgia, Alabama, Mississippi, Louisiana, and Texas. The "worm" stage of this insect feeds on the developing buds and young leaves and often destroys the new growth as fast as it develops. Spraying with calcium in Bordeaux during midsummer is recommended.

Pecan cigar case-bearers are of less importance than is the nut and leaf case-bearer. This insect feeds on the buds and foliage of the hickory, black walnut, and pecans. The eggs are deposited on the foliage and these hatch within a short time. After feeding first on the foliage as leaf-miners and later on the leaves, the worm forms a cigar-like covering or case about itself and attaches itself to the twigs, branches, or trunk of the tree to remain over winter. Spraying is usually not necessary, but with heavy infestation, spray with arsenate of lead as recommended for other case-bearers.

Spray Schedule.—Besides a winter spray of oil emulsion or lime-sulfur for scale insects, four other sprayings may be neces-

sary if diseases and eating insects are prevalent. Use Bordeaux mixture with one pound of powdered arsenate of lime to each 50 gallons at each of the applications. The times suggested are: (1) when nuts are the size of garden peas; (2) ten days or two weeks later; (3) two to three weeks after No. 2; and (4) about August 15 to 30.

Job 11. Harvesting, Grading, Curing, and Packing

Conditions Usually Found.—In commercial groves, crops are handled according to certain market demands. Practices of individual small growers are very irregular, often resulting in poorly graded, improperly cured, and badly packed nuts.

Aims.—Every student should understand and practice the most approved and economical methods of harvesting, grading, curing, and packing pecans.

Problems for Study and Discussion

1. What are the most economical methods for gathering pecans used in your section?
2. How is maturity of the crop determined?
3. What grading standards are used in grading pecans?
4. Describe the grades for the best varieties.
5. How is grading done most economically?
6. How are pecans cured?
7. What types of packages are best for selling pecans locally? For wholesale shipment?

Activities.—Participate in all of these lines of preparing the crop for market.

Judging Maturity.—When the nuts are ripe, the husks may begin to crack from the nuts, and the nuts fall to the ground. When this stage is reached, harvesting should begin promptly. This is usually about September or October. (Fig. 165.)

Harvesting Nuts.—There are two common methods of gathering pecans: (1) let the nuts ripen and fall naturally from the trees and pick them from the ground; (2) remove the nuts from trees when ripe but hanging in the husk, using long poles. The latter method offers the advantage of having fewer losses of nuts, less exposure to the moist soil, and less labor in removing empty husks from the trees.

The prices paid for harvesting vary according to the variety, yield, condition of soil, and methods used. Usually about two cents per pound is paid. A good, fast worker may harvest from one to two hundred pounds per day.

Grading pecans.—To sell best the nuts must be properly and correctly graded. Most varieties are separated into three sizes or grades. These grades may be numbered as Nos. 1, 2, and 3.

The National Nut Growers Association recently proposed the following: Extra Fancy, Fancy, and Standard. These sizes or grades are defined by variety groups:

Group 1.—Nuts which pass through a bore of 13/16 of an inch in diameter, but not through a bore 12/16 of an inch in diameter, and all larger nuts of the same variety, except when a third grade is to be used, shall be known as "Fancy" when of the following varieties: Alley, Aurora, Bolton, Claremont, Colorado, Delmas, Eggshell, Frotscher, Georgia, Hall, Haven, Kincaid, Moneymaker, Pabst, President, Randal, Russell, Sovereign, Stuart,

FIG. 165

FIG. 166

FIG. 165.—Fruiting habit of pecans, shown as the hulls are bursting. (S. C. Exp. Sta.)

FIG. 166.—Pecans from the orchard are taken next to a drying house for curing.

and Young. With the same varieties the term "Standard" shall apply to such nuts as will pass through either an 11/16 or 12/16 inch bore, but not through a bore 10/16 of an inch in diameter. Smaller nuts of these varieties shall not be given a grade standard.

Group 2.—These grade terms shall apply to the following varieties when 1/16 of an inch in diameter smaller than with the preceding sorts: Centennial, Halbert, James, Kennedy, Mobile, San Saba, Schley, Van Deman, and Waukeenah.

Group 3.—The diameters for those respective grades shall still further be decreased by 1/16 of an inch for the following varieties: Curtis, Moore, and Robson.

With any variety with which it is deemed best to establish a third grade, the term "extra Fancy" shall apply to such nuts as will not pass through a bore 13/16 of an inch in diameter for group 1, or through a bore 12/16 of an inch for group 2, or through a bore 11/16 of an inch for group 3.

With the following varieties, these diameter measurements shall be increased by 1/16 of an inch over those of group 1 for the same respective grades: Lewis, Nelson, and Success.

The Florida Station proposes variety grouping and diameter sizes as follows:

Variety	Diameter (inch)	Grade
Schley, Van-Deman, Pabst, and others of similar size and shape	15/16 or more 13/16 and 14/16 12/16 11/16 or less	Over 1 2 3*
Stuart, Success, Frotscher, and other standard varieties of similar size and shape	16/16 or more 14/16 and 15/16 13/16 12/16 or less	Over 1 2 3*
Curtis, Kennedy, Moore, and other varieties of similar size and shape	14/16 or more 12/16 and 13/16 11/16 or less	1 2 3*

* Nuts in grade three should be sold for cracking purposes only.

The sizing is done by means of a machine. There are several satisfactory makes of sizing machines on the market, two of which are offered by Robert E. Woodson, St. Louis, Mo., and by Atwood Nut-Cracker Manufacturing Company, Louisville, Ky. Much of the sizing is roughly done by hand methods as the nuts are rolled along a sloping surface.

Curing Methods.—The nuts are air-dried before being marketed (Fig. 166). These common curing or drying methods are used: (1) placing the nuts in a six-inch layer on the floor of a well-ventilated room or building; (2) placing the nuts in specially built drying houses or sheds which are equipped with shallow bins or shelves on which the nuts are spread to a depth of six inches; (3) sacking the nuts and placing them in the sun from day to day until dry, returning them to the house each night.

The nuts must be carefully and gradually cured; otherwise, shrinkage and poor quality will result. From 10 to 20 per cent is considered a normal shrinkage. Time required for curing is subject to weather conditions. One month should cure them fairly well.

Packing.—There are no well-accepted standard packages in which pecans are sold. The package types and sizes are regulated to a very great extent by market demands. If the grower is selling through well-organized associations, the nuts are usually sold in bulk and packed by the association in some stand-

ard or adopted package. Individual growers marketing their own crops use packages that vary in size, shape, and general makeup. The express and parcel-post packages may be made of light boards or of corrugated paper board. They may be of varying sizes from one to fifty pounds. For large shipments, the barrel, holding about 175 pounds, is the popular package. Some growers ship in bushel baskets having light covers.

Job 12. Marketing and Using Pecans

Conditions Usually Found.—Much of the pecan crop is marketed before Christmas. Most of the larger growers market through coöperative associations, but there is much individual selling.

Aims.—Students should consider and understand the different ways in which nuts may be marketed and decide which to use.

Problems for Study and Discussion

1. By what methods are the pecans in your section marketed?
2. What are the purposes of a marketing agency?
3. What conditions are necessary for the proper functioning of such an association?
4. Do you prefer the coöperative or the individual plan of selling? Why?
5. What do you think of special Christmas packages?
6. Discuss season for marketing.

Marketing of pecans should center about one selling manager. There has been a rather rapid development of coöperative marketing. When a selling association is formed it means higher and more satisfactory prices for the members. Individuals cannot compete with a strong organization in selling pecans to advantage. Where such an association functions properly the product is standardized, buyers are attracted, better outlets are found, packages are more uniform, and buyers and growers are better satisfied.

To function properly, an association must have a corps of reliable, honest, well-trained workers. It should be the duty of the growers to see that such an association does function, and is properly supported.

Uses.—Pecans have a wide variety of home uses throughout the country. Candy factories utilize car loads of nuts annually. Bakeries now use large quantities in their products. Aside from their many uses in salads and desserts, they constitute a favorable meat substitute. The flavor of the pecan is very agreeable and is not equaled by other nuts. The kernel has a blended

mellow flavor along with a high protein content, which makes it of high food value. The kernels give the consumer a combination of a very high sugar and oil content. The oil extract is very nutritious and digestible.

Job 13. Keeping Records

Records of pecan enterprises should be kept on forms similar to those given in the Melon Enterprise, or on forms secured from your State College of Agriculture. Keep special records of the pecan orchard, such as are suggested in the Peach Enterprise. Review the data given in Job 1.

State Station Publications on Pecans.—Write for state station publications on pecans. The following states have very helpful bulletins and circulars: Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, Texas, and others in the pecan-growing states.

Pecan Calculations.—1. A pecan orchard with the trees set 60 x 60 feet produced an average yield of 15 pounds of nuts per tree. What would be the value of the nuts at 15 cents per pound?

2. If a pecan orchard cost $120 the first year, $24 the second year, $26 the third year, $28.50 the fourth year, and $31 the fifth year, what would the grower have invested? Consider the rate of interest at 8%.

3. To produce 15,000 pounds of pecans a grower has to invest at the rate of 8 cents per pound. Had the same orchard produced 18,000 pounds, what would have been the cost per pound?

4. A grower desires to set 800 pecan trees in 60-foot checks. How many acres of land will he need?

5. Find the local cost of fertilizing the above grove with 5 pounds per tree of a 4-8-4 fertilizer.

6. Find the local cost of materials for making an arsenate of lead Bordeaux mixture. (Consider 2 pounds of arsenate of lead, 4 pounds of copper sulfate, and 4 pounds of lime to 50 gallons of water.)

7. A grower finds that he can sell his crop of pecans at 20 cents per pound at the time of harvest or he can cure them and secure 35 cents per pound. If the shrinkage is 15% and the curing costs $5.00 per hundred (harvest weight) which time should he sell?

8. The total investment for an acre orchard of pecans for the first ten years was $525. If the trees are set 50 x 50 feet and produce an average of 12 pounds of nuts per tree valued at 20 cents a pound, what rate of interest will be made annually on the investment?

Intercropping Orchards

Meets expenses of young orchards
Yields returns until trees bear crops
Induces cultivation of young trees
Supplies fertilizer residue to trees
Gives benefits of partial rotations
Calls attention to orchard conditions

ENTERPRISES WITH JAPANESE PERSIMMONS

Collaborator: G. W. Adriance, Ph.D., Professor of Horticulture, College Station, Tex.

Analysis into Jobs.—The following twelve jobs include the leading operations in an enterprise with Japanese persimmons. References are made to U. S. Yearbook, 1897; Fla. Buls. 71 and 205; Cal. Bul. 416.

1. Determining possibilities with persimmons, 685 F.
2. Choosing a variety.
3. Selecting the soil and site for the orchard.
4. Propagating or buying trees.
5. Preparing the soil and setting the trees.
6. Providing plant food; applying fertilizers.
7. Cultivating the orchard.
8. Controlling diseases and insects.
9. Pruning the orchard.
10. Harvesting, grading, and packing.
11. Marketing persimmons.
12. Keeping records.

Job 1. Determining Possibilities with Persimmons

Conditions Usually Found.—Japanese persimmons grow well in certain sections of the United States.

Aims.—Growers should know the requirements for success with this crop.

Problems for Study and Discussion

1. How long does it take for Japanese persimmons to produce profitable crops?
2. What areas of the United States are suitable for Japanese persimmons?
3. What is the cost per acre to grow trees to bearing age?
4. What yields should growers expect?
5. What prices are usually received for Japanese persimmons?
6. What difficulties do farmers have in growing this fruit?
7. What are the dangers of overstocking markets?

Where Grown.—The Japanese persimmon is a subtropical fruit. It is grown in the northern part of Japan and in many of the cooler sections of China. However, it produces more in the milder parts of these countries. The persimmon has failed

to grow satisfactorily as far north as Washington, D. C. As a general statement, the persimmon may be grown in about the same sections as the fig, or in the states comprising the cotton belt and in California.

The cost of producing an acre of persimmons up to bearing age will vary from one section to another, depending upon the rent of the land, the cost of the trees, the cost of fertilizer, and the cost of labor. The cost for growing an acre of persimmons is similar to the cost of growing peaches, except the cost of persimmon trees may be greater.

The yields vary according to the variety, the condition of the soil, the amount of fertilizer applied, and the season. The production per tree for the whole United States was recently averaged as 50 pounds. This includes all varieties and types of orchards. The average production of a well-kept orchard probably ranges from 75 to 150 pounds per tree. An acre should average around 10,000 pounds per year.

Prices of the fruit vary from year to year, depending upon the amount produced and other factors. The average price received during the past few years is about 7 cents per pound. In some cases 12 to 15 cents per pound has been received for choice fruit and 20 cents for extra choice fruit. If an average yield of even 5,000 pounds per acre could be maintained and even 5 cents per pound received for the fruit where grown, it would give profitable returns to the grower.

Job 2. Choosing a Variety

Conditions Usually Found.—Growers are trying many different varieties which are not the best.

Aims.—The best varieties for commercial plantings should be understood.

Problems for Study and Discussion

1. What are the different classes of Japanese persimmons?
2. What members of the persimmon family are found growing wild in America?
3. Make a list of the best of the astringent varieties.
4. Make a list of the non-astringent varieties.
5. What are the characteristics of a good commercial variety?
6. What varieties would you recommend for your community?

The Persimmon Group.—This fruit belongs to the Ebony family. This family comprises a large group of trees which find

wide use as ornamental, timber-producing trees, and as fruit-bearing trees. There are a number of members of this genus which are native to America.

Diospyros Virginiana is the native American persimmon found growing from Connecticut to Florida and as far west as Kansas and Texas. It is used extensively as a root stock for grafting or budding the Japanese persimmon. The fruit of this native tree is small but has a good flavor when it is thoroughly ripe. It is not grown commercially for fruit.

Diospyros Texana is a native of Texas. It produces a fruit that is extremely astringent until fully ripe. It is used to some extent as a source of dye for staining black.

Diospyros ebenaster is a native of Mexico and produces a green fruit resembling a large, oblate apple. The tree is too tender to grow in the United States.

Diospyros kaki includes all of the Japanese or Oriental persimmons. It is native to China but has been taken to all parts of the world. This group produces large fruit and is gaining favor in all of our markets in the United States.

Classification of Varieties.—There has been much confusion in the names of persimmon varieties ever since the importation of nursery stock from Japan. Dr. Hume (Fla. Bul. 71) first grouped the persimmons into three classes according to the color of the flesh: (1) dark-fleshed, (2) mixed light and dark, and (3) light-fleshed. It has been shown, however, that all varieties grown in the United States are light-fleshed when seedless. The varieties which make no change of flesh color when pollinated and the seed developed are called "pollination constants"; those which are dark-fleshed when the seed are developed and light-fleshed when seedless are called "pollination variants."

Pollination Constants.—The following varieties are light-fleshed when seeded or when seedless: Hachiya, Tsuru, Costata, Tanenashi, Tamopan, Phelps, and Triumph. Tamopan is an important variety.

Pollination Variants.—The following varieties are light-fleshed when seedless and dark-fleshed when seeded: Hyakume, Maru, Yemon, Godbey, Gosho, Zengi, Okame, and Yeddo Ichi.

Commercial Varieties.—Many of the different varieties have been planted in various sections. Growers are finding that a variety which produces large fruit is the best to meet market demands. The following varieties seem to be the ones now being planted for commercial orchards: Hachiya, Hyakume, Tanenashi, Tamopan, and Fuyu.

Hachiya has large fruit (3¾ x 3½ inches); color is reddish yellow; and is ordinarily seedless. The tree makes good growth and is often spreading. It is a mid-season variety.

Hyakume has fruit of medium size (2½ x 2⅞ inches); good flavor; thick skin; but poor color. The tree is a slow grower. Usually is not so good as the Hachiya or the Tanenashi. It is a mid-season variety.

Tanenashi is popular in the South. The fruit is large (2½ x 3⅛ inches); the color is light red; skin is firm; and shipping qualities good. The flavor is good, although the flesh is dry and mealy when compared with some of the other varieties. The tree makes a good growth but is not as vigorous as the Hachiya. This is a mid-season variety, with perfect flowers. (Figs. 167 and 168.)

Fuyu has medium to large fruit (2¼ x 3¼ inches); yellow flesh; fruit has a round flat shape which makes it easy to pack; very good quality; and perfectly non-astringent even when firm. The tree makes a vigorous growth.

FIG. 167

FIG. 168

FIG. 167.—Japanese persimmon tree propped to support its load.
FIG. 168.—Limb of tree in preceding figure showing cluster formation of fruit of variety Tanenashi.

Job 3. Selecting the Soil and Site for the Orchard

Conditions Usually Found.—Persimmons are grown on a wide range of soil types.

Aims.—How to select the soil for persimmons should be understood by the grower.

Problems for Study and Discussion

1. What kind of soil does the native persimmon (Diaspyros Virginiana) like best?
2. Which soil type is best for the Japanese persimmon?
3. How frequently are native persimmons killed by late spring frosts?
4. What exposure is best in regions where there is danger from late spring frosts?
5. Why is good air drainage important?

Soils.—The persimmon does not seem to be particular in its soil requirements (Fig. 169). The native persimmon also has a wide range of soil adaptation and it is generally used as the root stock. It may be found growing in both high and low lands.

Probably the best soil would be a sandy loam which is well supplied with organic matter.

In the northern limits of persimmon growth the occurrence of late spring frosts often prevents fruit. In such regions a northern or eastern exposure would delay the blossoming until after spring frosts are over. Air drainage helps in the prevention of damage by frost.

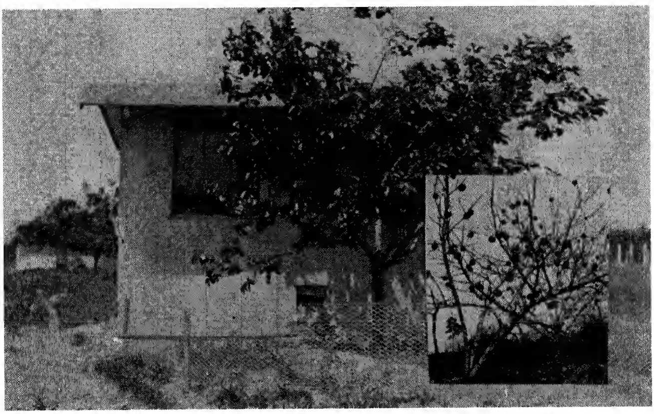


FIG. 169.—A tree of Japanese persimmons used for shade in a poultry yard. Insert shows fruit after leaves have dropped, because of fall frosts. (O. M. Edwards, Agr'l Teacher.)

Job 4. Propagating or Buying Trees

Conditions Usually Found.—Some growers propagate persimmon trees and others buy them from nurseries.

Aims.—The best methods of grafting and budding trees should be understood.

Problems for Study and Discussion

1. What kind of root stock is best for the Japanese persimmon?
2. How are seedlings produced?
3. What method of propagation is best for persimmons?
4. How many trees are needed for an acre orchard?
5. What age and size of trees are best?
6. How would you secure trees for your orchard?

Activity.—(1) Visit a nursery and learn how to propagate persimmons. (2) Find the prices of the trees from several nursery catalogs or by writing to nurseries.

Root Stocks for Persimmons.—There are several different kinds of root stocks which may be used for the Japanese persim-

mon. The three species commonly used are the *kaki*, the *Virginiana*, and the *lotus*. The trees grafted in Japan are on the *kaki* root stocks. The habit of growth of the *kaki* is to produce a long tap root, very much like the pecan, and to produce few fibrous laterals. The trees are hard to handle and are likely to die when set in the field. The *kaki* root stock is not as resistant to wet soils as the *Virginiana*.

The *lotus* species is now being used for root stocks in many sections, especially in California. The trees make a good growth and produce a good supply of fibrous roots. This root stock, however, is subject to infestation by crown gall, which may finally cause its disuse, except in California.

The native American persimmon (*Diaspyros Virginiana*) has been used in the South for years and is probably the best root stock that is available. It is adapted to a wide range of soil conditions and produces many fibrous roots which make it relatively easy to transplant. The seeds of this persimmon from which to grow the stocks can be easily secured in any section of the South. Trees are likely to be short-lived on *Diaspyros Virginiana*.

Growing the Seedling Stock.—It is the general practice to plant the seed in a seed-bed in the fall and not in nursery rows. After the seedlings are about twelve inches high they are transplanted into nursery rows. This practice produces better root systems.

The seedlings are set in the nursery in two-foot rows and placed six inches apart in the rows. They should be cultivated during the summer and grafted the following winter. In other words, it takes about one year from the planting date before the seedlings are grafted.

Methods of Propagation.—The Japanese persimmon is seldom propagated by budding. The patch-bud method has been tried with only fair success. The young seedlings may be budded in the spring as soon as the sap is flowing and the bark will slip, or in the fall before the sap quits flowing; however, this method does not give a satisfactory percentage of a stand or uniformity of growth.

Cleft Grafting.—Practically all of the nursery stock is grafted by using either the whip graft or the cleft graft method. Cleft grafting may be used where the seedling stock is large or

for top-working old trees. The stock is cut off squarely and then split through the center with a grafting knife. A scion is placed on either side of the stock so that the cambium layers will be in close contact. The scions are sharpened at the lower end so that the pressure from the stock will hold them in.

Whip grafting is practiced where the seedling stock is small. The seedling is cut off, just above the ground, with a long diagonal cut. The stock is then split vertically for a short distance. The scion is cut exactly in the same manner. The scion is then placed on the stock, the tongues of the two fitting together. The graft should then be wrapped with knitting cotton immersed in grafting wax, or with waxed cloth.

Age and Size of Trees.—The persimmon is usually grafted during the winter following the first year's growth. Seeds planted one winter may make seedlings large enough to graft by the following winter. In some cases, the seedlings are left until they are two years old before they are grafted.

Number of Trees per Acre.—Some varieties are much more spreading than others. Growers set trees 15 or 20 feet apart, each way, using 193 or 108 trees.

Job 5. Preparing the Soil and Setting the Trees

Conditions Usually Found.—Growers usually plow the soil with a turning plow and lay off the orchard rows similarly to those for a peach orchard.

Aims.—How to prepare the soil, how to lay off the orchard, and how to set the trees should be understood by the grower.

Problems for Study and Discussion

1. What methods are used in your community to prepare the soil for setting persimmons?
2. When are trees usually set?
3. What method of laying off the orchard is usually followed?
4. How should the holes be made?
5. How many holes per acre would you dig?

Activities.—Practice setting and caring for trees.

Preparing the Soil.—It is a good practice to turn the soil under with a two-horse turning plow several weeks before the trees are to be set. The soil should be cleared of all stumps, roots, and trees.

Laying Off the Orchard.—On level land most orchards are laid off by the check or square method. The trees are set fifteen

by fifteen feet or twenty by twenty feet apart. If the land is rolling, terraces should be run nearly level around the hill and the trees set on the terraces.

Setting the Trees.—The roots of a persimmon tree are stubby and have few fibrous branches as compared with other fruit trees. Special care must be taken in setting them. Do not allow the roots to dry out. Holes should be dug about two feet across and two to three feet deep, as tap roots are usually long. The roots should be spread out as much as possible. All broken or torn roots should be pruned off and the cuts disinfected. The top soil should be used for filling in around the roots. It is well to pour a bucket of water in each hole after the top soil has been put in. The trees should also be watered later if the weather is dry. After the soil has been packed around the tree, head the tree back to a height of about thirty inches.

Job 6. Providing Plant Food; Applying Fertilizers

Conditions Usually Found.—Few growers give the orchard proper fertilization.

Aims.—How to fertilize the persimmon orchard should be understood by the grower.

Problems for Study and Discussion

1. Of what importance is organic matter in the soil?
2. How may organic matter be supplied? Why are legumes important?
3. How is fertilizer applied?
4. What fertilizers would you recommend for persimmons?
5. What kinds of fertilizers are used in your community?

Fertilizing the Persimmon Orchard.—The Japanese persimmon is benefited by the application of fertilizers. Potash is considered very beneficial. The application of about five pounds per tree of a fertilizer analyzing 4 to 6 per cent nitrogen, 8 to 10 per cent phosphoric acid, and 4 to 6 per cent potash should give satisfactory results on heavy loam soils. Use one pound per year of age of the tree.

Green Manure.—The nitrogen may be applied in the form of green manure by turning under legumes. Some organic matter may be applied by using well-rotted barnyard manure in each tree hole when planting. A winter cover crop may be sown in late summer, and in spring this growth is plowed under to form green manure. Such a practice each year will supply an abundance of plant food.

Job 7. Cultivating the Orchard

Conditions Usually Found.—Growers usually practice clean cultivation during the spring months.

Aims.—How to cultivate the persimmon orchard should be understood by the grower.

Problems for Study and Discussion

1. What implements are needed for cultivating the persimmon orchard?
2. How early in the spring should tillage begin?
3. Outline an annual plan of orchard tillage, including the sowing of cover crops.
4. Suggest good cover crops to grow in your region.
5. Give reasons for growing an annual cover crop.
6. What are the benefits of intercropping?

The cultivation of the persimmon orchard should be much the same as that given peach orchards or citrus groves. On most soil types, the soil should be given frequent cultivations during the spring months and discontinued when the summer rainy season begins. One deep plowing in the early spring should be enough if followed by harrows or cultivators often enough to keep the soil free from grass and weeds.

Annual Plan.—The winter cover crop may be plowed under as green manure in early spring. Disking or harrowing with a spike-tooth harrow should follow this immediately and be continued until time to sow the next winter cover crop in late summer. A good cover-crop mixture is one bushel rye, one peck hairy vetch, and one-half peck crimson clover seed per acre.

Intercropping.—When the trees are young, intercrops of truck or other money crops such as are recommended in the Peach Enterprises may be grown between the rows of trees. This plan will give a money return for the area while waiting for the trees to come into bearing. It gives an added incentive to cultivate and fertilize.

Job 8. Controlling Diseases and Insects

Conditions Usually Found.—Very few serious insects and diseases attack persimmons.

Aims.—How to identify and how to control each insect and disease enemy should be understood by the grower.

Problems for Study and Discussion

1. Make a list of the insect and disease enemies of persimmons found in your community.

2. Describe diseases and their effects.
3. What damage is done by the different insects?
4. How are these enemies controlled?
5. Report opinions of growers regarding enemies on a stringent vs. non-astringent sorts.

Activities.—Collect specimen insect enemies of persimmons and mount them for study.

Persimmon Diseases.—Very few diseases attack the persimmon badly enough for the grower to be interested in the problem of control measures.

Persimmon Insects.—A number of persimmon insects have to be considered by the grower. Among the most important of these insects are persimmon borer, San José scale, twig girdler, and the white peach scale.

Persimmon borers make a tunnel on the inside of the trunk and are hard to control. In some cases, they may be dug out with a knife or with a stiff piece of wire.

San José scale insects may be controlled by spraying the trees with lime-sulfur, winter strength, while the trees are in the dormant stage.

Twig girdlers also work on many of our hardwood trees, such as the hickory, the pecan, and the oak. They seem to like the persimmon best of all trees. The eggs are laid beneath the bark of the twigs, the female then making a straight cut around the twig so that the twig containing the larva hatched from the egg later falls to the ground. The only control measure is to pick up the twigs as they fall and burn them to destroy the insects.

White pecan scale insects may be controlled by using a lime-sulfur wash applied to the dormant trees. One application can be given in December and another in February.

Job 9. Pruning the Orchard

Conditions Usually Found.—Many growers neglect the pruning of orchards and thereby have poorly formed trees.

Aims.—Growers should know the reasons for pruning and how to prune persimmon trees economically.

Problems for Study and Discussion

1. What pruning should be given to a tree when it is set?
2. How is the head of the tree formed?
3. What annual pruning should be given to trees of bearing age?
4. What pruning implements are needed?
5. At what season should pruning be done?

Pruning Young Trees.—This type of orchard does not need as much pruning as the peach or a number of the other kinds of orchards. . The young trees should be headed back to about thirty inches when they are set. The next spring four or five

main limbs should be left for the framework of the tree, the growth below these limbs being removed. After these limbs of the main framework have grown for a year they should be pruned back from one-third to one-half of their length, depending upon the amount of growth. The pruning needed after the second year is to remove cross limbs or to head back limbs that are making too rapid growths.

Pruning Bearing Trees.—A minimum amount of pruning is recommended for bearing orchards, the renewal of the fruiting wood being about all that is required. Dead, diseased, and broken limbs should be removed. The fruit is borne on the growth of the current season, hence the necessity for thinning limbs enough to keep the growth vigorous.

Securing Annual Crops.—In many places some varieties have a tendency to bear in alternate years. It has been shown in California that thinning the fruit increases its size, and increases the tendency to annual bearing.

In years when a heavy crop is borne it may be necessary to prop and brace the trees, especially where the main framework of the tree is weak. This can be done by means of wire bracing or by propping with poles.

Job 10. Harvesting, Grading, and Packing

Conditions Usually Found.—Persimmons are picked before they are fully ripe. Many growers do not grade the fruit.

Aims.—How to pick, grade, and pack persimmons should be understood by the grower.

Problems for Study and Discussion

1. At what stage should the fruit be picked?
2. How is the fruit picked from the tree?
3. What care must be given the fruit in handling?
4. What are the standard grades for persimmons?
5. How are persimmons packed?
6. What kinds of crates are used for shipping persimmons?
7. What length of time may persimmons be kept in cold storage? Give temperature.

Harvesting Persimmons.—This fruit is never picked from the tree with the hand but is clipped with a pair of ordinary orange clippers. The cut is made close to the calyx and the short stem left attached.

The proper stage of ripeness for picking varies with the

variety. In general, the fruit should lose most of its greenish color before it is picked. The grower needs to learn the exact stage of ripeness by experience with each particular variety. For home use the fruit may be left on the trees until it is fully colored. Birds often damage the fruit if left on the trees after it becomes soft.

Special care must be taken not to bruise the fruit in picking.

Grading Persimmons.—Many growers have failed to grade persimmons and it has greatly handicapped them in marketing the crop. There are no set standards for grades in most of the states. The fruit could be graded according to size and color into approximately three grades: fancy, choice, and culls.

Packing Persimmons.—The crate used for packing persimmons is the common four-basket or six-basket peach carrier, or the peach crate of California, which contains two layers of fruit when packed. The individual fruits should be wrapped with a good grade of paper. In placing the fruit in the basket, care should be taken to pack the calyx ends of two layers together. The apex of the fruit has a sharp point which may damage the other fruit if no regard is taken in placing the fruit properly. See that each basket is packed tight.

Cold Storage.—Persimmons may be kept in cold storage. The best temperature, according to California Station trials, is probably around 30 degrees F. Practically all varieties show a tendency to soften if the temperature is kept as high as 36 degrees.

Job 11. Marketing Persimmons

Conditions Usually Found.—Most growers ship on consignment to northern markets.

Aims.—How to market Japanese persimmons should be understood by growers.

Problems for Study and Discussion

1. What are the best markets for Japanese persimmons?
2. How are persimmons sold in your community?
3. How is the fruit shipped?
4. Report opinions of growers regarding improvement of market conditions.

Marketing Persimmons.—Very few growers in the South can make car-lot shipments and very few markets would consume that much fruit. The general practice is to make express ship-

ments or to ship the persimmons in a car with other fruits. In some places the fruit is sold through fruit auctions; however, the bulk of the crop is consigned to commission merchants. The range of prices received is from 6 to 20 cents a pound at the orchard or at the loading point.

Job 12. Keeping Records

Persimmon records should be kept as for other enterprises. Use the forms given in the Melon Enterprise. Also follow the suggestions for special records given in the Peach Enterprise.

Calculations.--1. A young grower had an acre of persimmons set 20 x 20 feet which produced an average of 75 pounds of fruit per tree. What was the fruit worth at 12 cents per pound?

2. At $40 per hundred, what would be the cost of enough persimmon trees to set an acre if the trees are 18 x 18 feet?

3. How many fruits would be needed for a six-basket crate if eight fruits are needed per layer and two layers per basket?

4. Japanese persimmons were successfully introduced into the United States in 1875. How many years have they been grown here? If they have increased at the rate of 40% each 10 years over the preceding decade, what is the present percentage of increase over the first decade?

Success with Persimmons

Choose mild climate
Guard against late spring frosts
Select variety to suit region
Grow trees on *Virginiana* stocks
Fertilize young and bearing trees
Intercrop and cultivate trees
Prune to cause annual cropping
Wrap and pack fruit carefully
Market crops very promptly

ENTERPRISES WITH FIGS

Collaborator: G. W. Adriance, Ph.D., Professor of Horticulture, College Station, Tex.

Analysis into Jobs.—The following are the jobs in an enterprise with figs. References are to U. S. Farmers' Bulletin 1031 (Revised), and to state bulletins, particularly from Georgia, North Carolina, and Texas.

1. Determining possibilities with figs.
2. Choosing varieties to plant, 732D.
3. Selecting the field and the soil.
4. Propagating figs and caring for the nursery.
5. Buying nursery stock.
6. Preparing the soil and setting trees.
7. Fertilizing the fig orchard.
8. Cultivating the fig orchard.
9. Pruning figs.
10. Controlling insects and diseases.
11. Harvesting, grading, and packing.
12. Marketing figs.

Job 1. Determining Possibilities with Figs

Conditions Usually Found.—Figs are grown for home use in practically all sections of the southern states. Few sections grow them for commercial purposes, Texas being the leading southern state.

Aims.—Growers should analyze all factors and decide whether or not fig growing would be a profitable enterprise.

Problems for Study and Discussion

1. How long does it take before a fig orchard comes into bearing?
2. What is the average cost per acre in your community for growing figs to bearing age?
3. What yields do growers realize?
4. Where would growers of your region market their fig crops?
5. Why are so few figs grown for market?
6. Give the impressions of growers as to the future outlook for fig culture.
7. What prices have been received for figs in your community?
8. What trouble do farmers have in growing and marketing figs?
9. To what extent are growers increasing or decreasing in their production of figs?

Climatic Adaptation.—Figs may be grown in practically all sections of the southern states where the winters do not get too

cold. From Virginia to Texas the coastal plain is where most fig trees are found. The distribution of bearing trees given by a Census Report is as follows:

State	*Number of trees*	*State*	*Number of trees*
Mississippi	24,921	Alabama	44,386
North Carolina ...	6,692	Florida	22,136
South Carolina	16,893	Georgia	39,223
Texas	166,273	Louisiana	46,276
Virginia	4,457		

The production in California exceeds that in Texas. The total crop in 1928 was eleven million boxes of fresh figs and ten thousand tons of dried figs.

The young trees will not stand as much cold as the older trees. The main commercial sections for fig growing in the southern states are along the Gulf coast of Texas and in several sections of Louisiana.

Available Markets.—Figs grown in a humid climate as is found in the southern states are very perishable. In damp weather the fruit may sour on the trees. For this reason ripe fruit cannot be safely shipped to distant markets, except probably in car lots under refrigeration. Most of the fig crop is either canned or dried and then put on the market. Probably in the southeastern states the best way to market figs is either in the preserved or in the canned form.

Age of Bearing Trees.—Figs come into bearing at an early age. Often fruit may be seen on the small trees in the nursery. A farmer should not expect to secure much fruit, however, until about the third and fourth years.

Costs per Acre.—Many factors are taken into consideration in determining the costs per acre for growing figs. Up to bearing age the costs would not be much greater than for a peach orchard of the same age.

Yields.—The season, the variety, and the size of trees all affect the yields. A young orchard will probably average from a few quarts to a bushel per tree. Old orchards should yield from one to five bushels per tree. Averages from forty growers in Galveston County, Tex., show acre yields in pounds by years: 2nd, 700; 3rd, 1,200-1,400; 4th, 2,500-3,000; 5th, 4,000 and over; 5th year and after, 5,000.

Prices.—From season to season, prices vary. Usually better prices are received for fresh fruit sold on the market than for

fruit sold for preserving or canning. The fresh fruit usually retails for ten to fifty cents a quart. Magnolia figs for canning bring the growers three to four cents per pound.

Labor Requirements.—At harvesting time extra labor is usually needed because the fruit should be picked daily.

Job 2. Choosing Varieties to Plant

Conditions Usually Found.—Many different varieties are found that are grown for home use. Magnolia, Brown Turkey, and Celeste are probably the leading varieties.

Aims.—Growers should select the best variety for commercial purposes.

Problems for Study and Discussion

1. What are the qualities of a good commercial variety?
2. What varieties are being grown in your community?
3. List the varieties of figs according to the colors of the fruit.
4. Compare varieties in yield, and in handling qualities.
5. What variety will suit best on your farm?
6. Why should only one variety be grown in any one region?

Qualities of a Good Variety.—Several points need to be considered in selecting a variety to plant. The trees should be able to withstand the winter; the fruit should not crack; the fruit should be of good quality; and the trees should be heavy bearers.

Types of Figs.—This crop is usually divided into two classes as follows: (1) the Smyrna and (2) the common. The Smyrna fig is not adapted to the southeast because its flowers have to be pollinated or caprificated by pollen from a wild fig. This is done by a wasp-like Blastophaga insect. These insects have not been able to survive our winters in large enough numbers to make Smyrna fig growing profitable. Experiments to succeed in this are being conducted along the Atlantic coast and the results look rather promising for the future.

The common fig is grown in many of the European countries and in the southeastern states. The fruit of this fig develops without the flower being pollinated by insects.

Varieties of the Common Fig.—In the commercial orchards of Texas the Magnolia variety is used. In the southeastern states the Celeste is probably the leading variety. Other varieties grown in the southeastern section are the Brown Turkey, Lemon, Brunswick, Ischia, and San Pedro. The Celeste and the Brown Turkey seem to be more hardy than the other varieties.

Magnolia is the commercial variety used in Texas, but in the other southern states it does not do well. The fruit is pale green, large, and of good quality. The fruit begins to ripen in July and continues until late fall.

Celeste is grown for home use around practically every home where figs can be produced, east of the Mississippi River. The fruit is small to medium in size; pear shaped; the skin purplish brown in color; pulp whitish, shading to a pinkish red; the fruit of extra good flavor. The season opens usually in June or early July and extends for a period of several weeks.

Brown Turkey has from medium to large fruit with a coppery-brown skin. The pulp is whitish, shading to pink around the seeds, and has good quality. This variety is excellent for making preserves. The season is about the same as for the Celeste.

Lemon fig fruits are from medium to large in size, yellowish green in color, with light oval dots. The quality is only fair, but it makes a heavy yield. The season is from early July to August.

Brunswick makes a small growth but does not stand cold very well. The fruit is large, broadly pear shaped, with a bluish-purple skin. The quality is good.

Ischia fruit is medium in size, and pale green in color. The pulp is crimson in color and the quality is very good. The season opens about August and extends until late fall. It is good for home planting.

Job 3. Selecting the Field and the Soil

Conditions Usually Found.—Figs do best around the yard. The exposure is of little importance.

Aims.—Growers should understand the factors to consider in selecting the soil and field for figs.

Problems for Study and Discussion

1. Why is the selection of the soil and field more important for figs than for annual crops?
2. On what kind of soil is the nematode usually found?
3. Why do figs thrive better around the yard than in orchards?
4. What soil conditions are desirable for growing figs?
5. What kind of soil in your community is best suited for figs?

Location for Figs.—It is important that the fig orchard be conveniently located. The exposure seems to be of little consideration. However, the majority of the growers select a northern slope to prevent the trees from starting growth too early in the spring.

Soils for Figs.—This crop will grow on a wide range of soil types, wherever the proper physical conditions are present. The soil for figs must be well drained, well supplied with moisture, and rather fertile. There are several objections to a light sandy soil. This kind of soil fails to retain moisture, becomes

extremely warm in the summer, is usually the type in which nematodes thrive, and is usually low in fertility.

Silt and alluvial soil along the larger streams is good for growing figs. It is usually fertile, well supplied with humus and moisture, less subject to heat in the summer, and less subject to nematode trouble.

The clay loam soils are used in some places for fig growing, especially in Texas, where moisture is an important factor.

Job 4. Propagating Figs and Caring for the Nursery

Conditions Usually Found.—Practically all of the fig trees are propagated from cuttings. Trees are sometimes grown at home and sometimes obtained from nurseries.

Aims.—Growers should be able to make fig cuttings and to grow them properly in nursery rows.

Problems for Study and Discussion

1. What method is used in your community in making fig cuttings?
2. At what season of the year are the cuttings made?
3. Describe the treatment of the cuttings until ready for planting in the orchard.
4. Describe the practices of local growers regarding the depth of planting the cuttings and the distances apart for the rows.
5. What other methods could be used in propagating figs?

Activities.—Visit a fig orchard and make a bundle of cuttings. Grow the cuttings for a season.

Methods of Propagating.—Figs are so easily propagated by cuttings that other methods are seldom used. They may be propagated by layering, by grafting, and by budding. The cuttings are made during the dormant period of the tree, from well-developed wood which was grown the year before. These cuttings should be from eight to twelve inches in length and should contain at least two or more joints. The length of the cuttings depends somewhat on the vigor of the trees. The cuttings should be severed just below and just above the nodes. Any portion left above or below the last node may decay and probably injure the whole cutting.

Setting the Cuttings.—In practically any section of the southern states the cuttings may be set in the nursery as soon as they are made. They may be tied in bundles and stored in moist sand until spring, when they are set out.

The nursery is laid off in rows four to five feet apart, and

the cuttings are placed from ten to twelve inches apart along the furrows. The cuttings are placed deep enough so that the top bud of each is just above the top of the soil, which should be pressed well around them.

Caring for the Nursery.—The young fig nursery should be kept free from weeds or grass by practicing frequent shallow cultivation. Special care must be taken not to hit the cuttings with the cultivating implements, as the buds are easily injured.

Job 5. Buying Nursery Stock

Conditions Usually Found.—Practically all growers produce trees from cuttings. Few buy them from nurseries.

Aims.—Growers should understand the kind of nursery stock to purchase.

Problems for Study and Discussion

1. Where could you obtain fig trees?
2. What age and size of trees would you select?
3. How many trees would you need per acre?
4. Describe the characteristics of good nursery trees.
5. How can the presence of nematodes be detected?
6. Of what importance is a nursery inspection certificate?
7. What does a certificate not guarantee?

Age of Trees to Buy.—Since it is possible to grow trees from two to five feet in height in one year from cuttings, it is usually desirable to select only the one-year-old trees. Nursery trees should be selected which have good root systems, and should be three to four feet in height.

Where to Buy.—Purchase the trees from a reliable nursery just as near the farm as possible. It is well to visit the nursery and make your own selection of trees. Never buy trees from a traveling agent. Inspect the trees for diseases and be sure there are no swellings on the crowns or roots which may harbor nematodes. Such trees should be burned and the nursery should replace them with good trees.

Job 6. Preparing the Soil and Setting Trees

Conditions Usually Found.—The soil is usually broken deep and otherwise well prepared. The holes are dug for the trees by hand, and trees are set deeper than they grew in the nursery.

Aims.—The student should understand the reasons for preparing the soil well and for digging large holes for trees. Each student should know how to set trees.

Problems for Study and Discussion

1. Describe how local growers prepare soil for figs.
2. How would you prepare the soil?
3. How large should the holes be made?
4. To what depth would you set the trees?
5. At what time of the year would you set figs in the orchard?
6. Under what conditions would watering at setting time be advisable?

Activities.—Practice digging holes and setting fig trees until you are satisfied you can do the job well.

Preparing Soil for Planting.—It is best to prepare the soil rather deep for figs. The soil is broken from eight to ten inches deep and then well disked or harrowed. Lime is used to good advantage on some soils and is usually applied at the time of harrowing.

The rows are laid off with shallow markers or are staked by sighting and measuring. They are spaced ten to twenty-five feet apart each way, depending upon the variety and the fertility of the soil. Calculate the number per acre.

How to Set the Trees.—Set trees in November or March. Wet the roots with water and keep covered with clean burlap sacks. Remove broken or injured roots and twigs. Spread the roots out without bending too much. Set trees about an inch deeper than they grew in the nursery. Use top soil among and around the roots.

Trees should be pruned to suitable form and height when planting.

Job 7. Fertilizing the Fig Orchard

Conditions Usually Found.—Fertilizing soils for figs is usually practiced by progressive growers.

Aims.—Students should know the kinds of fertilizers to use in growing figs, and methods of applying them.

Problems for Study and Discussion

1. What methods of fertilization are practiced in your community?
2. How would you apply commercial fertilizer to figs?
3. When would you fertilize the trees?
4. Of what importance is lime as a fertilizer for figs?
5. What cover crops are grown in your community in the fig orchard?

Time of Year to Fertilize.—Most fig growers apply the fertilizer in the early spring just before the trees commence their growth. An early to midsummer application of quickly available fertilizer may be made if the trees are not making satisfactory growth. Lime is usually applied in the winter.

Value of Green Manure.—For adding humus to the soil, grow crimson clover, winter vetch, Austrian winter peas, or vetch and peas in combination during the winter, to turn under in spring as green manure.

Fertilizers for Figs.—Few experiments have been conducted by stations to determine the best fertilizers for figs. It is the common belief that lime is valuable and that it should be applied every three or four years. Barnyard manure applied at the rate of ten or twelve tons per acre is very valuable. A mixture of commercial fertilizer containing 5 per cent nitrogen, 8 to 10 per cent phosphoric acid, and 5 per cent potash would probably be desirable. This may be applied at the rate of 1,000 pounds per acre. Some growers use bone meal at the rate of 1-2 pounds per tree.

Job 8. Cultivating the Fig Orchard

Conditions Usually Found.—Fig growers usually cultivate their trees rather shallow. Too few growers use winter cover crops in the orchards.

Aims.—Students should understand how to cultivate figs. The annual management should be understood.

Problems for Study and Discussion

1. What is the depth of roots of fig trees during the growing period?
2. What implements are needed for cultivating figs?
3. Of what value is a soil mulch?
4. What is the practice in your community for cultivating figs?
5. Why should weed growth be prevented?
6. Outline a plan for tillage of a fig orchard when a cover crop is to be grown each winter.

Cultivating Figs.—The trees are easily injured by weeds and grass. The feeding roots of the fig grow near the surface of the soil and, for this reason, very shallow cultivation should be practiced. A disc and spike-tooth harrow are probably the best implements to use during the summer. Frequent tillage will kill weeds before they are large enough to be seen.

In early spring after danger of frost the soil may be broken shallowly with a turning plow to turn under a green manure crop and all forms of litter. Never plow it more than three or four inches deep and stay well away from the trees.

The main object in summer cultivation is the keeping down of grass and weeds (Fig. 170).

Job 9. Pruning Figs

Conditions Usually Found.—Growers usually follow some system of pruning figs. Several systems are in use.

Aims.—Students should learn how to prune figs by different systems and should know the advantages of each.

Problems for Study and Discussion

1. What system of pruning is followed in your community?
2. What are the different systems of pruning for different orchards?
3. What advantages do you see in each system?
4. Why would you prune figs?
5. What implements do you need for pruning?
6. At what time of the year would you prune figs?

Activities.—Practice pruning trees according to different systems. Compare the results of different systems.

Reasons for Pruning.—Figs are pruned to open the tops so that sunlight and air may be admitted, to remove deadwood, to

Fig. 170.—A small fig orchard, showing height of young bearing trees. Note the clean cultivation. (Seaboard A. L. Ry.)

keep the trees in the desired shape, to aid in harvesting, and to produce a better quality of fruit. Most varieties produce figs on the current season's growth. (Fig. 171.) Wherever new growth is stimulated, there is a possibility of producing more fruit.

Methods of Pruning.—We find three methods of pruning being practiced: 1. The leading method is probably pruning to form a bush. The bush form training is used to advantage where protection from cold is necessary. This system of pruning, in addition to being better for protection against cold, is desirable because the fruit can be harvested so easily. After the trees are several years old, all the pruning that is necessary is to remove sprouts and dead branches and do some thinning. If the trees are killed from cold they should be cut back near to the surface of the soil.

2. Pruning to a single stem produces a fig tree. This is

practiced only where winter killing is uncommon. The trees are headed back at planting time to about eighteen inches. The tree then is allowed to grow without much pruning except the removal of dead branches and perhaps thinning the head each year.

FIG. 171.—Method of bearing fig fruit. (Seaboard A. L. Ry.)

3. The semi-renewal method of pruning is practiced in Texas for the Magnolia variety. The fig is allowed to develop one main trunk and the whole top is cut back each winter.

Job 10. Controlling Insects and Diseases

Conditions Usually Found.—Soft-rot, rust, three-lined fig-tree borers, nematodes, and the common green June beetles are the most important enemies of the fig.

Aim.—Students should be able to recognize the several insects and diseases and know how to control them.

Problems for Study and Discussion

1. Enumerate the enemies which are troublesome in local fig plantations.
2. Which of these give growers greatest trouble?
3. Give the symptoms and the control of soft-rot.
4. How may the three-lined fig-tree borer be controlled?
5. Give the effects of nematodes. How would you prevent this trouble?
6. Describe the work of green June beetles.
7. Give suggestions for reducing the injury done by these beetles.
8. Describe the appearance of rust disease.
9. What procedure is recommended against rust?

The soft-rot is found only on the ripe fruit. It is caused by a fungus similar to that which causes a black mold to form on stale bread. During rainy weather this disease is much more serious. No remedy is effective, except that fruit should not be harvested while it is damp. Fruit should also be harvested before it gets dead ripe.

Rust disease causes light-colored pimples on the under side of the leaves, which die and fall off. Often the tree is completely defoliated by the middle of the summer. Sunburn will then do considerable damage. The Texas station found that Bordeaux, 5-5-50, applied early and repeated every thirty days, was the most effective remedy.

Three-Lined Fig-Tree Borer.—This insect injures the wood of the tree. The larva bores into the wood and lives there for two or three months before it comes out as a grown beetle. The beetle is grayish-brown, with three white stripes, one extending down the middle of the back and one on each side. The antennæ are more than twice as long as the body of the beetle.

This insect seems to prefer weak or dying trees. The only remedy, where the insect is found in a healthy tree, is to dig it out with a long blade of a knife.

Nematodes.—This trouble is caused by very small parasites which live in small roots of the trees, causing knot-like swellings. They seem to be more abundant in light, sandy soils. No effective measure of control can be given, except measures of prevention. Special care should be taken in selecting nematode free soil and nursery stock free from this pest. Figs are very susceptible and the nematode is probably the most serious pest.

Common Green June Beetles.—These insects are found on the ripe fruit, which they bite, making it unfit for the market. It is possible to catch these insects by hand and destroy them in a bucket of kerosene. Many may be trapped at night in pans

of water covered with kerosene, by placing a bright lantern or other light over the pan.

Fig Mealybug.—A meal coated, apparently soft bodied insect often infesting the leaves, branches, and fruit. Sanitary measures, together with clean-up sprays, are the recommended control measures.

Job 11. Harvesting, Grading, and Packing

Conditions Usually Found.—Fresh figs are picked by hand from the tree and are seldom graded before packing for market.

Aims.—Students should understand the value of proper grading and packing and should know how to do these well.

Problems for Study and Discussion

1. How are figs usually harvested?
2. How are the fruits handled?
3. What containers are used for packing figs?
4. Give reasons for and against grading figs.
5. Make a schedule for these three operations.

Activities.—In an orchard, practice the picking, grading, and packing of figs.

Picking Figs.—Care has to be taken by pickers to prevent the juice from coming into contact with the hands. This is done in several different ways. Some pickers oil their hands and arms while other pickers use cotton gloves.

The fruit is either cut from the tree with a sharp knife or pulled by being caught and given an upward jerk. The stem is left on. The fruit must be handled with special care. The trees should be dry when fruit is picked, and the picking should be done every day. Pick while it is still firm, because soft fruit cannot be marketed or used to best advantage.

Grading and Packing.—Figs should be graded according to size and ripeness. Most growers use the quart baskets, similar to those used for strawberries, for packing figs. Either twenty-four or thirty-two quart baskets are placed in a crate.

The fruit in the bottom of the basket is placed with the stems up, and the next layer with the stems down. The top layer should have the stems placed down.

Job 12. Marketing Figs

Conditions Usually Found.—Fresh figs are usually consigned to some commission merchant.

Aims.—Students should know the methods of marketing figs.

Problems for Study and Discussion

1. What part of the fig crop is canned?
2. To what extent are figs dried in your locality?
3. What methods of marketing do growers use?
4. Of what importance is refrigeration in shipping the fresh fruit?
5. What prices are usually received by growers?

Canning Figs.—For home use, canning is practiced in many sections of the southern states. In Texas it is done on a commercial scale. The fruit may be packed in glass jars or in cans. It is cooked in a heavy syrup for two to four hours. Figs may also be preserved in thick syrups and then canned.

Drying Figs.—In California it is possible to dry figs by the heat of the sun, but in the southern states some artificial heat must be used. In some cases both methods are used. The artificial method consists of dipping the fruit into a lye solution to remove the skin, washing the fruit, and then placing it in trays where a temperature of 115 degrees F. is kept until the fruit shrivels. The temperature is then raised to 145 degrees and maintained for a number of hours. The dried figs are usually pressed in bars and wrapped with paper before they are put on the market.

Marketing Fresh Figs.—This product is marketed in much the same way as other perishable fruit. Much of the crop is consigned to commission merchants. In a few sections enough fruit is produced to market it through a coöperative marketing association.

Much of the fresh fruit is sold locally to hotels, restaurants, and local fruit stores or grocery stores, or may be shipped to such institutions elsewhere. If shipped they should reach the consumers in twenty-four hours from picking time. Fresh figs are extremely difficult to ship and market satisfactorily.

Calculations.—1. Where figs are set 15 x 15 feet, what will the trees cost an acre at $15 a hundred?

2. If a fig orchard set 15 x 15 feet produces 2 bushels of fruit per tree, what would the grower receive per acre if a quart sold at 15 cents?

3. Determine the amounts of fertilizer used per acre for figs if 4 pounds are applied per tree, set as in problem 2, per acre.

4. What is the cost of fertilizer per acre at $35 per ton?

5. Which would pay better: to sell 250 bushels of figs at 15 cents per quart or to preserve them, if the 250 bushels would make 5,000 quarts of preserves valued at 50 cents per quart? The cost of preserving the figs is considered 12 cents per quart for the finished product.

Success with Figs

Plant where winters are mild
Avoid nematode-infested soil
Choose variety suitable to purpose
Propagate trees by cuttings
Grow for home and local market
Extend plantation to suit markets
Cultivate and fertilize regularly
Suit pruning to variety and growth
Control borers, rust, beetles, and mealybugs
Pick fruit while firm and dry
Pack fruit in quart baskets
Can, dry, or sell while fresh

STRAWBERRY ENTERPRISES

Collaborators: C. R. Wilkey, M.A., Professor of Agriculture, Teachers College, Conway, Ark.; M. E. Gardner, B.S., Professor of Horticulture, State Agricultural College, Raleigh, N. C.

Strawberries are grown under a range of climates from the Tropics to Canada. In the United States harvest begins in Florida in December, from which state berries are shipped to northern markets until mid-spring. In the other southern states the berries ripen during the spring months, beginning in March in Louisiana and Alabama. The berry harvest moves north with the season, ending in July or early August in the most northern states.

In the southern states, the fresh market is the chief outlet for berries, although an increasing percentage of the crop is frozen for use as a dessert fruit on American dinner tables, for further manufacture into preserves or into ice cream.

Analysis into Jobs.—The following units include the main operative and managerial jobs involved in the Strawberry Enterprises.

Job 1. Determining Possibilities with Strawberries

Conditions Usually Found.—Strawberries are grown for market in practically all the southern states. When the crop is properly handled, growers usually make a profit.

Aims.—Growers should know the different factors necessary for profitable production of strawberries for market.

Problems for Study and Discussion

1. How many acres of strawberries are grown in your community?
2. Report opinions from several farmers regarding the average cost per acre to produce strawberries.
3. Give the bearing age and average life of a patch, in years.
4. What is the average yield to expect in your community?
5. What have been the average local prices received for strawberries during the last five years?
6. What special labor requirements are necessary in growing strawberries?
7. Where can pickers be secured at harvest time?

Commercial Regions.—Strawberries are grown in the following southern states, which are listed in the usual order of

production, the 1934-1943 average production in thousand twenty-four quart crates being shown: Louisiana, 1,196; Tennessee, 639; Arkansas, 804; Florida, 493; North Carolina, 530; Virginia, 450; Alabama, 260; Mississippi, 24; and Texas, 112. The commercial crops are shipped to northern markets. They may be grown for home use in practically any section. The cultural practices in the South are quite different from those used in the North, and they vary in the different states.

Cost per Acre.—The cost of producing an acre of strawberries varies greatly from one section to another, depending upon the soil, the season, the amount of fertilizer used, the cost of labor, and other factors. It probably ranges from $75 to $150 per acre. The average cost is probably more than $100 per acre for the first year, and less for subsequent years, with a corresponding decrease in returns.

Yields per acre vary, depending upon richness of the soil, season, amount of fertilizer used, method of planting, and the age of the plants. Counting results of poor and good growers, the average is over 60 crates to the acre. Good yields reach 100 to 200 crates.

Price to Expect.—Strawberries usually range in price from 40 to 50 cents per quart at the first of the season down to 10 or 15 cents the latter part of the season. The average prices vary between these figures according to the production, demand, and marketing conditions.

Labor Requirements.—The most strenuous labor seasons for strawberries are at setting and at harvest times. Sometimes special groups of pickers are organized and travel from one strawberry section to another as the season advances. From three to ten pickers per acre are required during the main season. If schools are not in session, many children, as well as men and women, may be employed. Sometimes schools are closed during strawberry harvest. When factories use all available surplus labor the picking problem is serious.

Job 2. Choosing Varieties to Grow

Conditions Usually Found.—Farmers usually select one variety which suits the local conditions. Sometimes two or more varieties are grown.

Aims.—How to select the best varieties to suit local soils and to meet market conditions should be understood.

Problems for Study and Discussion

1. What varieties are grown in your community?
2. What are the qualities of a good shipping variety?
3. Under what conditions should two or three commercial varieties be grown?
4. What would be the disadvantages of planting several varieties?
5. Discuss soil adaptations for varieties.
6. Give advantages of local growers using the same varieties.
7. What information is needed concerning the flowers?
8. Where should new varieties be tested?

Variety Characteristics.—There are two general classes of strawberries, namely, the standard and the ever-bearing. The ever-bearing varieties produce a crop in the spring and then continue to bear some fruit until frost. These are of little commercial importance. The standard varieties usually produce only at one time of the year, except under irrigation.

Varieties are found with perfect or with imperfect flowers. (Fig. 172.) The blossoms of a perfect variety contain all the parts of a complete flower, i.e., the calyx, the petals forming the corolla, the stamens, and the pistils. The imperfect flowers have no stamens developed enough to produce pollen. If the variety has imperfect flowers, it must be planted with a variety which has perfect flowers. As a general rule, few growers plant varieties of the imperfect type because of the danger of mixing the berries at harvesting time. Where both types are planted, probably the best plan is to set two to four rows of the imperfect variety and then one or two rows of some perfect variety. The perfect or staminate variety pollinates the others. The two varieties used must blossom at the same time.

The season of ripening should be considered in selecting a variety. Commercial fields in the South usually require early varieties to meet high market prices. Heavy yielding varieties should be used. Firmness of flesh is required for long shipments.

The variety selected should be adapted to the climate and soil. Some varieties produce well in one section and make a failure in another. The experience of local growers is valuable in this regard.

Two leading varieties grown in the South are the Premier and the Blakemore. These varieties make good crops of early berries and the fruit stands shipment well. The Missionary is used extensively in Florida. Other varieties grown in certain

sections of the South in a limited way include Gandy, Klondike, Klonmore, and Aroma.

New varieties are being tried in many places; however, the experiment station should probably lead in testing and recommending new sorts.

Klondike.—This is an early-bearing variety which has perfect flowers. It fruits well and the berries are medium-large, smooth, and of a uniform shape. The flesh is red, acid, and firm. The leaves are very resistant to disease and the fruit ships well. It is one of the leading varieties for the South.

Missionary.—It is an early variety used very extensively in Florida. The fruit is usually firm in Florida but in other sections it seems to be softer than the Klondike. The berry is medium in size, conic in shape,

FIG. 172.—Strawberry blossoms on left have stamens and pistils and are called perfect. Those on the right have no stamens, are called pistillate, and must be grown near a perfect variety to produce fruit. (*New Agriculture,* Davis.)

dark crimson in color, and the flesh dark red and acid. The foliage is resistant to disease.

Lady Thompson.—This is a vigorous, early variety which is productive and has perfect flowers. The fruit is of good quality, somewhat more oblong in shape than the Klondike. The flesh of the berry is red, acid, and firm. This variety does not ship as well as the Klondike. It is very good for home gardens, where it is much used.

Gandy.—This is a late variety and is seldom used in the extreme South. In some sections the foliage is attacked by leaf-spot disease. The fruit is rather irregular in shape, deep crimson in color, and red fleshed. The quality is good and the fruit usually ships well. It is well suited to clay soils.

Excelsior.—This is a berry of good quality which ships well. The season is very early. The foliage is easily attacked with leaf spot and the variety is not used extensively on that account.

Aroma.—This is a mid-season or late variety and is not used in the extreme South where an early crop is important. The flesh is firm, of sub-acid flavor, and of good quality. It makes a very good shipping variety.

Premier (Howard 17).—An early berry of good quality, very productive and a good shipper. The berries are uniform in shape, large, and have an attractive, red color. The plants are resistant to disease and adapted to a wide range of soil types. The flowers are perfect.

Blakemore.—This is a new U. S. Department of Agriculture development of much promise. Plants are somewhat more vigorous than Missionary, with foliage more resistant to leaf spot. It is slightly earlier than Missionary in North Carolina, and more productive. The berries are a bright, light red which does not change on holding. Good shipper. The blossoms are perfect.

Job 3. Selecting the Soil for Strawberries

Conditions Usually Found.—Most commercial growers select soils well suited to strawberries, but some mistakes are made in having too little organic matter or in having soil enemies present.

Aims.—Growers should be able to select the best type of soil for strawberries, and know when it is free from soil enemies.

Problems for Study and Discussion

1. What type of soil is used for strawberries in your community?
2. Of what importance is drainage?
3. What slope and exposure would you select?
4. Of what special value is vegetable matter in strawberry soils?
5. How can organic soils be chosen which are free from grub worms?
6. How would the location of roads be of importance in selecting the field?
7. How can freedom from nematodes in soil be determined?

Selecting the Soil.—Strawberries are adapted to a wide range of soil types; that is, some varieties may be found which thrive on heavy soils, while certain other varieties are best adapted to light soils. Soils ranging from a sandy loam to a light clay loam are probably the best kinds for strawberries.

The light soils help to hasten the earliness of the crop and are important in the South. These soils, however, suffer from drouth unless plenty of organic matter is supplied. Many growers select a black shady loam rich in organic matter so that moisture is usually available. Select soil that is extremely fertile for strawberries, or else be certain that plenty of plant food is applied as fertilizer.

Organic Matter.—If soils are light, organic matter aids in holding moisture and makes plant food more available. Heavy soils are also improved by organic matter as crops are earlier and drainage is better. Turning under a grass sod as green manure may cause serious attacks by grub worms. Much barnyard manure may bring the same trouble. A good plan is to

turn under an annual crop, such as crimson clover, vetch, or rye, which is not likely to be infested with grub worms.

Drainage.—Special precautions should be taken to see that proper drainage is available. Water should not be allowed to stand on the soil. The soil can usually be drained by tile or by open ditches. The land should slope enough to afford proper drainage.

Exposure.—Air drainage is also important in some sections where late frosts may do considerable damage to the blossoms. A slope towards the south usually produces earlier berries, but endangers the blossoms more. On level farms air drainage is difficult.

Near Good Roads.—The land for strawberries should be located on good roads so that the berries will not be injured in hauling. Long hauls over rough roads may be the cause of losing the fruit in transit.

Freedom from Nematodes.—Many farms have nematodes present in the soil. This is true on many of the light sandy soils. The nematodes are very injurious to strawberries and special care should be taken to avoid all infested soils. Crops formerly grown, such as tomatoes, soybeans, or root crops, may show nematode infection. If so, such fields should not be used for strawberries.

Job 4. Propagating and Buying Plants

Conditions Usually Found.—Many growers order their plants from nurseries, while others produce them.

Aims.—Growers should be able to propagate strawberry plants and should know what to purchase.

Problems for Study and Discussion

1. By what methods are strawberry plants propagated?
2. Describe the selecting of plants from a field, as to size, age, and other qualities.
3. From what sources do the farmers of your community secure their plants? Give their reasons.
4. Debate: Raising vs. buying plants.
5. How many plants are needed to plant an acre?
6. How are strawberry plants packed for shipment?
7. What are pedigreed plants?
8. How are new varieties produced? Who should do this?

Activities.—Practice selecting good plants from an old field, a propagation field, or when renovating a field.

Propagation.—Strawberry plants are usually propagated by means of runners. The plants send out cord-like stems and at each node or joint a cluster of leaves forms. Later, roots are formed at each joint which enter the soil and form a new plant. Often each runner may produce three or four new plants. Plants propagated by this method are true to name because they are a part of the old plant. Rooting of runners may be hastened by covering the ends with soil (Fig. 173).

If new varieties are desired, the seeds from berries are planted. The seedling plants thus produced may vary greatly

Fig. 173.—Student's project. Method of propagating plants for fall setting. (L. J. Larson, Agr'l Teacher.)

from the parent plant. Such a method of propagation is seldom used, except by plant breeders at nurseries or at experiment stations.

Buying Northern Plants.—Many growers have a special field for propagation purposes, while others take the plants from the runners produced from the fruiting rows. If a special field is used, it is set with new plants each year and all are dug, only the best ones being used for planting.

In the extreme South many growers obtain a few plants from the North each year to set the propagation field. The plants are set in the propagation field from January to March. These "mother plants" start growth and produce primary plants by June. The June-set plants should produce more plants by August. Plants set in August produce more plants for the main crop to be set in October or November. By this practice a grower is enabled to produce enough plants for his whole crop

by the purchase of only a few plants each year. Much work is involved in three transplantings.

In some other sections, new plants may be ordered from the North and propagated as described, but where the season is shorter the young plants are moved only twice—June or July and the late fall.

Securing Home Plants.—If new plants are not to be purchased from northern growers, they are commonly taken from

FIG. 174.—Strawberry plants received from nursery ready to be heeled in or planted promptly. Left, unpruned. Center, pruned roots. Right, single plant, to be planted to a depth just above the roots.

fruiting fields, from fields being renovated, or from old fields being plowed up. After the picking season ends, if a field is to be abandoned, the plants are plowed up and the best crowns are selected for use in a new field.

Choosing Plants.—Primary plants, next to the mother plants, are strongest. Choose plants with thick, healthy crowns and abundant, healthy roots; free from nematodes; with leaves showing no disease and having good color.

Digging Plants.—Strawberry plants should be dug with a spade, a trowel, or a plow, depending upon whether or not the entire row is to be taken up. By using the spade the soil may be dug up with the plants, although this practice is seldom

used. The trowel is used where the plants are taken from the fruiting rows. A plow is used in renovating and turning under old beds, at which time many growers select plants for new fields. (Fig. 174.)

Purchasing Plants.—Be certain to place orders early, and buy only from a grower who has plants free from disease. There is danger of the plants being heated in transit, and therefore it is usually best to secure them from near home if the weather is warm.

Pedigreed Plants.—Some dealers advertise "pedigreed plants" for sale. These plants are grown from carefully selected plants, but the price asked for such plants is extremely high. It is doubtful whether the grower is justified in paying the prices asked, except in the case of securing a few plants for propagation.

Packing Plants.—Plants for shipping are dug and put up in bunches of twenty-five. These bunches are properly tied and the roots covered with moss. The bunches are shipped in baskets or crates, with the tops exposed.

The number of plants required to set an acre depends upon the distance between the rows, the distance between plants, and the method or system used. The number required probably ranges from 8,000 to 15,000 plants. When plants are set twelve inches apart in three-foot rows approximately 15,000 are required per acre.

Job 5. Preparing the Soil and Setting the Plants

Conditions Usually Found.—Soil for strawberries is given careful preparation. The plants are set by hand.

Aims.—Growers should know how to prepare the soil for strawberries, how to set the plants, and what system to use.

Problems for Study and Discussion

1. At what time of the year would you prepare a field for strawberries?
2. What implements would you need in preparing the soil?
3. What planting systems are used in your community?
4. Debate: Hill-row vs. matted-row system.
5. How deep should strawberry plants be set?
6. At what time of the year would you set strawberry plants?
7. Describe the organization of a planting crew for economically setting strawberries.
8. Why are planting machines not used for setting strawberries?

Activities.—Practice setting strawberry plants, and time the operations. (Fig. 175.)

Preparing the Soil.—The preparation of the soil for strawberries should be thorough. If sod land is to be used, the preparation should be started a year or two in advance, to prevent having grub worms in the field. These worms live in sod soils, and would injure strawberry roots.

If an annual crop has been growing on the field, the green manure may be plowed under about a month before setting time. The fields should be harrowed several times during this month to sprout and kill weeds, to destroy insects, to mellow the soil, and to conserve moisture.

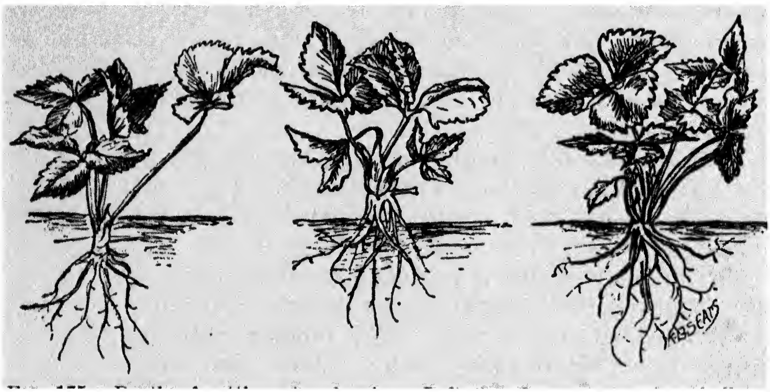


FIG. 175.—Depth of setting strawberries. Left, too deep; center, too shallow; right, correct depth. (Sears, *Productive Small Fruit Culture.*)

If the land used for strawberries is low, the plants may be set on slight ridges. Otherwise, the rows are laid off with a marker which opens slight furrows for setting the plants.

Time to Set Plants.—Plants may be set either in the fall or in the spring. Usually plants are set from August to October and allowed to bear a good crop the following season. If set in the spring, plants are not allowed to bear the first season.

Systems of Planting.—The two common systems of planting used are the hill-row system and the matted-row system.

The matted-row system is common in the North Carolina and Virginia sections and is found in other places. The distances between rows and between plants depend upon the variety, the fertility of the soil, the moisture supply, and the system to be followed. The rows are placed from three to five feet apart, and matted rows are allowed to spread one or two feet.

This system is used only where several crops of berries are to be harvested from the same planting.

The hill system is used in practically all of the states from South Carolina to Texas. The plants are set in late summer or early fall and a crop harvested during the winter or early

FIG. 176.—The double-hill system of setting strawberry plants, 22,000 per acre, for a winter or early spring crop. Scene at harvest time. (Seaboard A. L. Ry.)

spring. In this system the plants may be set in single, double, or triple rows. The single or the double rows are generally used (Fig. 176). For the single-hill rows the plants are set twelve to fifteen inches apart in rows three feet apart. In the double-row system two rows are placed about twenty inches apart, and then an alley of two and one-half to three feet is left between each pair of double rows.

Setting Promptly.—The plants should be set just as soon as they are taken from the propagation field, or just as soon as

they arrive from shipment. Special care should be taken not to allow the roots to dry out. The best time to set plants is late in the afternoon or during a cloudy day.

Pruning.—It is a good practice to cut off part of the roots of each plant to about four or five inches in length. Pruning is very conveniently done while the plants are in bunches by use of an axe and wooden block. Usually about one-half of the foliage is also removed, leaving about two leaves.

Depth of Setting.—The plants should be set so that the crowns are level with the top of the soil after it has been packed about the roots. Do not set the plants too shallow or too deep (Fig. 175). For this reason, machine setting is seldom practiced.

Methods of Setting.—The plants may be set by hand, using a spade, a trowel, or a dibble. If the soil is loose and mellow or if the furrows are opened with a marker, the plants may be set by hand. One boy distributes plants ahead for several men setting them. One person may set plants by the dibble method, which takes more time. Where a spade is used, two men are involved. One makes the hole with the spade and the other inserts the plant. The first man then removes his spade and tramps the soil down around the plant. This is one of the most widely used methods of setting plants.

Setting by machinery may be used on level land where the soil is in good condition. It takes one man to drive the machine and two to set plants. The main trouble with the transplanting machine is that plants are not set at the proper depth. Its chief advantage is in watering the plants, if the weather is dry.

Job 6. Supplying Plant Food

Conditions Usually Found.—Most growers use some form of fertilizer for the strawberry crop.

Aims.—The best methods of supplying plant food for strawberries should be understood.

Problems for Study and Discussion

1. What kinds of fertilizers are being used in your community for strawberries?
2. What kinds of fertilizers are recommended by your experiment station?
3. At what time of the year should the fertilizer be applied?
4. What are the results if too much nitrogen is applied?

5. Get fertilizer prices and calculate the saving that could be made by home-mixing.
6. What are the methods and rates of applying commercial fertilizers to strawberries locally?
7. Which would you prefer for strawberries, barnyard manure or commercial fertilizers? Why?
8. How much fertilizer can be saved by turning under a good crop of crimson clover before planting?

Activities.—Practice mixing and applying fertilizers for strawberries.

Feeding the Plants.—The matter of fertilizers is largely a local question because soil conditions vary in different sections. A few points, however, should be kept in mind: (1) Strawberry plants feed within a few inches of the top soil. (2) The berries mature in a short time. (3) Nitrogen applied in too large quantities may lessen the shipping quality of the berries. (4) Lime seems to be harmful to strawberries.

Barnyard manure is a very valuable fertilizer for strawberries. The best practice is to apply it to the crop preceding strawberries. An application of five to ten tons per acre spread broadcast should be made prior to the planting of the previous crop.

Green manure should be plowed under before setting strawberries. A good crop of clover will save buying commercial nitrogen.

Commercial mixtures to suit all conditions are difficult to recommend. Some growers use a 3-8-3, 4-8-4, or 4-10-4 (N-P-K) mixture. The mixture depends upon how much barnyard manure or green manure was used. The rate of application depends upon soil conditions. As a general rule, growers use from 800 to 2,000 pounds per acre. The fertilizer may be applied in the rows previous to setting, or part of it may be applied a few weeks after setting (Fig. 177).

Job 7. Caring for the Strawberry Field

Conditions Usually Found.—Growers realize the need of caring for the strawberry field if good crops are to be produced.

Aims.—Growers should know how to renovate a field, how to control blossoms and runners, and how to mulch.

Problems for Study and Discussion

1. In what sections do growers remove flower stems? Why?
2. What growers in your community remove runners? How is this done? Why?

3. Under what conditions would you mow and burn a field in renewing a strawberry plantation?
4. How are strawberry plants thinned?
5. Of what value is mulching?
6. How much mulching is done and what materials are used? When applied? When removed?

Activities.—Practice cutting runners, removing flower stems, renovating patches, and mulching strawberries.

Duration of Fields.—In extreme southern sections where the hill system is used growers plow under the strawberry field

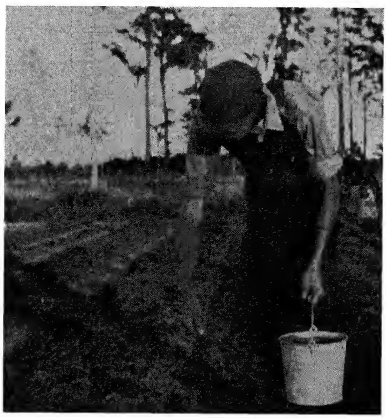


FIG. 177.—Student fertilizing strawberry plants, using a 4-8-4 (N-P-K) mixture prepared himself. (L. J. Larson, Agr'l Teacher.)

at the close of the first fruiting season. Plants set out in late summer or early fall may bear a good crop the following winter or spring. In early spring the field is turned under and some other crop is planted. This requires setting a new field every year. Thus land is held for strawberries only one winter. The rapid rotation helps to keep many of the strawberry insects and diseases in check.

Growers using the matted-row system usually renew the field until it is four or five years old. The duration length usually depends upon the soil conditions, diseases, insects, and nematodes.

Renovation.—In renewing the field the grower cuts the plants off with a mowing machine a short time after the harvesting

season. The plants thus cut off may be turned under to furnish vegetable matter. Where diseases and weevils are bad, the field may be raked and the trash burned before plowing. The trash and the mulch may be raked in rows down the middles and burned when the wind is blowing in the right direction so as not to injure the crowns.

The plants may be reduced in number by thinning. The amount of thinning needed depends upon the variety, the season, and the soil. The usual practice is to plow under one side of the row together with the old plants in the middle, leaving the other edge of the row for the renewed patch. These plants may be further thinned by running a spike-tooth harrow once or twice across the rows and once down the row. The plants left put out new foliage and the field soon has the appearance of a new plantation.

Fig. 178.—A berry picking tray carrying eight quarts. Note the straw mulch between rows.

Removing Flowers.—Where plants are set in the spring it is unwise to allow fruiting the first season. If rather weak plants are set in the fall, it may also be a good practice to prevent them from fruiting the first spring. This is done by removing flower stems as they begin to develop. The practice is seldom used for the hill system in the extreme South because only one crop is desired after setting the plants.

Managing Runners.—If the hill system is used, the runners must be kept off. The object is to get the plant to produce fruit rather than to allow the strength of the mother plant to go to produce new crowns. The removal of runners also prevents the crowding of plants.

The runners may be removed by one of several methods: (1) by using a hoe to cut them off, (2) by using a dropper which resembles a post-hole digger, (3) by means of shears or roller cutters, or (4) by special cutters attached to cultivators. Probably the use of a hoe is the best method. Runners are seldom removed in the matted-row system of planting.

Mulching Strawberries.—It is the usual practice with strawberry growers to use some kind of mulch. The purposes of the

mulch are (1) to keep the berries from getting sandy, (2) to conserve the moisture supply, (3) to keep down weeds and grass, (4) to improve the condition of the bed for picking, (5) to prevent the soil from baking, (6) to prevent the soil from heaving, and (7) to protect against frost.

Mulch Materials.—In the South, growers usually use pine needles and flat-land "wire grass" for mulching. Pine needles are easily obtained and make a satisfactory mulch. Oat, rye, or wheat straw may also be used if available. (Fig. 178.)

Mulching in the One-Year System.—When the hill system is used, the mulch is usually applied just before the plants are ready to bloom. The mulch is applied between rows and then worked toward the plants.

Mulches on matted rows are applied more as a winter protection, covering all the plants. They are raked to the middles before spring growth begins.

Removal of mulch materials usually follows immediately after the picking season. If the patch is to be retained, the mulch may be either burned with a high wind or may be cultivated into the soil if diseases and insects are not serious.

Job 8. Cultivating Strawberries

Conditions Usually Found.—Good cultivation is more commonly found in the hill system than in the matted-row system.

Aims.—Growers should understand the reasons for cultivation and should know economic methods.

Problems for Study and Discussion

1. When should cultivation of strawberries begin?
2. What implements are needed in cultivating strawberries?
3. What are the main reasons for cultivating strawberries?
4. Report the frequency of cultivation in your region.
5. When should cultivation cease?

Implements Needed.—The implements used in cultivating strawberries vary greatly. The same implements used for the cultivation of all general truck crops are satisfactory. Many growers use a one-horse cultivator which may be adjusted to cover the space between rows. In certain places, the spike-tooth harrow is used. It is usually necessary to practice some hand hoeing no matter what other implements are used.

Cultivating Strawberries.—There are several objects in view: (1) to keep down the grass and weeds, (2) to conserve moisture, (3) to liberate plant food, (4) to aërate the soil, and (5) to incorporate mulching materials or fertilizers.

The strawberry has shallow roots; therefore, it is very important to keep a dust mulch on the soil. The soil should be tilled with a cultivator after each rain. The cultivation should commence just after the plants are set and continue until the straw mulch is applied or until nearly fruiting time if no mulch is applied.

Job 9. Controlling Insects and Diseases

Conditions Usually Found.—Strawberries are attacked by several diseases and insect enemies which must be held in check.

Aims.—Growers should learn to recognize enemies and know how to control them.

Problems for Study and Discussion

1. What insects and diseases damage strawberries in your community?
2. Give control measures for white grubs. For weevils. For root aphids.
3. How may leaf spot be controlled?
4. Give preventive measures against nematodes.
5. What is considered to be the worst enemy of the strawberry in the South? In your region?
6. Debate: Strawberry enemies vs. apple enemies.

Strawberry Insects.—The main insect enemies of the strawberry in the South are the white grub, the strawberry weevil, and the root louse. While nematodes are not insects, these minute worms attack the crowns and roots.

The white grub is the larva of the May or June beetle. The adult female deposits her eggs in soil having many roots. The eggs soon hatch and the young feed on the roots of the growing plants. They develop into yellowish-white grubs with brown heads and black abdominal tips familiarly known. It usually takes about two years for this insect to complete the life cycle.

There seems to be no satisfactory method of control, except to select land which has been in clean cultivation. Avoid planting strawberries on sod land. An annual crop does not attract these insects and hence green manure can easily be grown as short-season crops.

The strawberry weevil is one of the snout beetles. Colors vary from reddish-brown to black. The adults hibernate during the winter under trash of any kind and visit the strawberry field in the early spring. The beetles feed on the developing pollen. The eggs are laid inside the blossom buds which are then girdled off to give the young a good place to develop.

All possible hibernating places should be destroyed and the field located away from the woods. It is possible to hold weevils in check by planting part of the field with a variety which has imperfect flowers or little pollen. Dusting with one part arsenate of lead mixed with six parts sulfur is effective.

The root louse or aphis feeds on the roots of strawberry plants. The eggs are laid on the strawberry leaves in the fall. These eggs hatch in the spring and produce wingless females. The females are carried down to the roots of the plants by ants. They multiply rapidly and the young are brought forth alive rather than by eggs. Both males and females are produced in the late fall and eggs are laid to be hatched the following spring.

A necessary control measure is not to set plants in infested soil. To kill any lice present, the plants should be treated with a weak solution of nicotine sulfate before they are set in the field. Dusting or spraying with nicotine when eggs are hatching in the spring will destroy the lice before they are carried into the soil.

Nematodes are parasitic eel worms which attack the plant roots and cause knots or galls. They injure the growth of the plants, causing serious damage in many sections.

The pest has a number of host plants so that control measures are difficult. Peaches, apples, raspberries, blackberries, figs, and various farm and truck crops are hosts to this pest. Avoid planting strawberries in infested soil. Peanuts, corn, oats, velvet beans, and iron cowpeas may be planted on infested soil.

Strawberry Diseases.—The main diseases of the strawberry are the leaf spot, the leaf scorch, and the white buds.

The leaf spot appears on the leaves as grayish spots which sometimes have reddish borders. These spots have all of the tissues killed and are, therefore, unable to help manufacture plant food. A wet soil favors the disease. Some varieties are more resistant than others. The disease may also be held in check by spraying with Bordeaux mixture. Mowing and burning vines after picking, and annual plowing up of fields holds the disease in check.

The leaf scorch is sometimes taken for leaf spot. The disease causes large, irregular-shaped purplish blotches. One blotch may run into another and finally cause the whole leaf to be discolored. The flowers are attacked as well as the leaves. The disease may be held in check by spraying with Bordeaux mixture. Clean-up measures are also helpful.

The white buds disease if present causes the central part of the plant to twist. No central bud will develop and no fruit is produced. Experienced strawberry growers are able to recognize this disease in propagation fields and discard the diseased plants. All plants which are not healthy should be discarded.

Job 10. Harvesting, Grading, and Packing

Conditions Usually Found.—Growers usually pick the berries and pack them without very much grading.

Aims.—When to harvest berries, how to grade them, and how to pack for shipment should be understood.

Problems for Study and Discussion

1. At what stage of ripeness are strawberries picked for market?
2. How many pickers are needed for an acre?
3. Describe how strawberries are picked.
4. What price is paid in your community for picking strawberries?
5. What precautions are necessary to prevent injury in harvesting strawberries?
6. What picking equipment is necessary?
7. How are strawberries graded?
8. What kind of packing house is best?
9. How many baskets are packed in different types of crates?
10. What type of crates would you use for packing strawberries?

Activities.—Practice picking, grading, and packing until you understand all details.

Picking Strawberries.—It is hard to know the exact degree of ripeness for picking. This depends upon the distance to market and the firmness of the variety. For local markets, berries should be allowed to become fully ripe before they are picked. If they are to be shipped to a distant market the common practice is to pick them when the berries are about three-fourths colored. (Fig. 179.)

FIG. 179.—Picking scene on strawberry project, Columbus Co., N. C. (Atlantic Coast Line Ry.)

Pickers should be engaged before the berries are ready to pick. As a general rule, pickers are paid by the basket or quart. Some growers give a bonus at the end of the season for all pickers who have stayed with them for the entire season. The prices paid pickers vary from one section to another, depending upon the price of labor.

The amounts picked daily vary. The yield per acre also varies. It usually takes two to ten pickers per acre, depending upon the yield and the speed of picking.

The pickers are usually grouped under a manager, whose duty is to see that the work is well done. (Fig. 180.) He manages the pickers by seeing that the following points are observed: (1) Each picker is assigned to a special row. (2) Each picker has a six-basket carrier with a handle. (3) The berries are picked with the calyx and about one-fourth of an inch of the

stem is left on the berry. (4) The rows must be picked clean whether or not the berries are suitable for market. (5) The berries should be graded by the pickers into at least two grades. (6) Special care must be taken to avoid bruising.

As a general rule, growers pick strawberries every other day at the first of the season and every day at the height of the season. The berries should be picked when they are dry and carried immediately to the packing shed, as it is poor practice to let them remain in the sun any longer than necessary. The crates for picking should be clean, and the hauling to the packing shed and to market should be done as carefully as possible.

Grading Strawberries.—If the pickers are reliable, the grading of strawberries can be done in the field. This practice causes less injury to the berries because they do not have to be rehandled. Some growers find it necessary to regrade them at the packing shed. A table should be provided on which the berries are placed for grading. A box table with a piece of cloth stretched over the frame for the top is a very satisfactory type of table. Some growers use a metal grading pan which accommodates one quart, with every berry in sight for inspection. Holes permit sand to fall through, and only the cull berries are removed by hand. The quart is then refilled by pouring. Be certain to grade berries into grades in which they will be of the proper size. Some growers use two grades and others have three grades, 1, 2, and culls. Culls are seldom shipped to market.

The Packing Shed.—The usual packing shed for strawberries is a very inexpensive structure. The shed is constructed by placing posts in the ground and covering the roof tight enough to keep out sun and rain, leaving the sides and ends open. Tables should be provided under the packing shed.

Kinds of Crates.—Strawberries are packed in quart baskets and then into light crates each holding twenty-four or thirty-two baskets (Fig. 180). In some cases, crates of other sizes may be used. In the Virginia district a sixty-quart crate is sometimes used. In Florida the pony refrigerator crate, which holds sixty-four or eighty quarts of berries, is used to some extent. This crate is provided with a metal tray, either at the top or in the center, which is filled with ice. In extremely early producing sections pint boxes and crates to suit are often used.

Packing Strawberries.—After the berries have been graded they are placed in quart baskets. Be certain to see that the berries are the same size throughout the basket. Another point to remember is that the baskets should be full. The top is usually faced with berries arranged in an attractive manner.

FIG. 180.—The standard berry crates hold three layers with eight quart boxes in each. Berries when packed are not all fully colored.

The calyx end is turned down in the facing, leaving only the red berry to be seen.

Job 11. Marketing Strawberries

Conditions Usually Found.—Most growers market strawberries by local and car-lot express shipments consigned to commission houses or through coöperative marketing associations. In larger producing sections, track buyers often purchase the berries at the shipping point.

Aims.—Growers should understand how to market strawberries well.

Problems for Study and Discussion

1. What are the different methods of marketing strawberries?
2. Of what value would a coöperative marketing association be for strawberry growers?
3. How may a grower obtain market information?
4. How does a grower determine where to sell his strawberries?
5. What method of transportation is used for shipping strawberries?
6. What would be the advantages of selling to buyers f.o.b. the track?

Methods of Marketing.—Strawberry growers may use the following methods in selling the crop: (1) sell to local cash buyers f.o.b. the track; (2) ship on consignment to commission houses; (3) sell through a coöperative marketing association; (4) sell to preserving plants; or (5) sell at auction.

Local Buyers.—If a grower sells to a local buyer for cash f.o.b. the track, he is certain of the amount he is getting from the shipment; however, these buyers usually pay low enough prices so that they can guard against market drops.

Consignments.—A shipment of strawberries consigned to a commission house may bring good returns to the grower or he may be called upon for express charges. The main trouble with this method of marketing is that no one grower is able to know the amount of strawberries being sent to the same market center.

Auctions.—In many places, buyers come to the strawberry sections and the fruit is sold each day at public auction, similar to the method so commonly used in the South for selling tobacco.

Marketing Associations.—Where coöperative marketing associations have been organized and conducted in the proper manner they have usually given satisfaction. In the strawberry section of Missouri practically all of the growers belong to an association. These associations get the daily market reports and are able to ship in cars. Either express or freight refrigerator cars are available on most of the railroads.

Market information may be secured from state marketing bureaus or from the United States Bureau of Markets.

A Good Coöperative Manager

Knows market needs
Understands marketing details
Has had experience with markets
Is honest and above reproach
Holds confidence of members
Studies needs of members
Takes risks when necessary
Seeks market outlets actively
Acts quickly and timely
Uses sound judgment
Bears criticism cheerfully
Looks far ahead wisely

A Good Coöperative Member

Grades and packs products well
Tries to produce best products
Discards culls and low grades
Thinks of market effects
Reports true farm conditions
Strives to help association
Knows methods and policies
Trusts fellows and manager
Keeps down all criticism
Makes helpful suggestions
Reports disorganizing activities
Ignores outside bidding

Job 12. Keeping Records

Strawberry crop records of production and marketing should be carefully kept and summarized. Also keep account of the yields and returns from different varieties, and of the prices received in different markets and at different dates. Students should first fill out a set of blanks by using data from a good grower.

Standard Calculations.—1. A boy has a piece of land in triangular form which has a base of 30 rods, and an altitude of 20 rods. How many acres does he have for his project?

2. How many plants will be needed to set the above area if the rows are to be set 3 feet apart and the plants set 12 inches apart in the rows?

3. To finance his project a young man had to borrow $125 for seven months at 8% per annum. What did he pay out as interest?

4. The labor cost of growing an acre of strawberries was $75, which was 60% of the total cost. Find the total cost of growing the strawberries.

5. An acre of strawberries produced 6,000 quarts. How many 32-quart crates were produced?

6. How much was received for these strawberries (problem 5), if they averaged $3.15 per crate?

7. From the results of problems 3, 4, 5, and 6, determine the rate of interest he made on his investment.

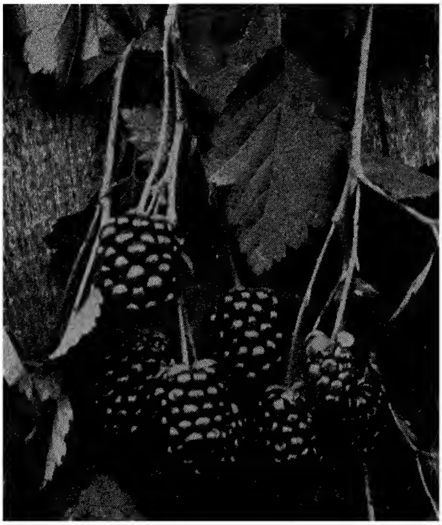


FIG. 181.—Fruit clusters of Lucretia dewberry. Note the long berry stems.

DEWBERRY AND BLACKBERRY ENTERPRISES

Collaborator: J. A. McClintock, Ph.D., Department of Horticulture, Purdue University

Analysis into Jobs.—An enterprise with dewberries or blackberries may be analyzed into the following list of jobs which include the farm and market units. References are to U. S. Farmers' Bulletins 1399, Blackberries; 1403, Dewberries; and 1488, Diseases. See also books in Appendix by Van Meter and by Card.

1. Determining the possibilities with dewberries and blackberries.
2. Choosing varieties to plant.
3. Selecting the soil and the location.
4. Propagating and buying plants.
5. Preparing the soil for planting.
6. Setting and training the plants.
7. Providing plant food; applying fertilizer.
8. Cultivating the plantation.
9. Controlling diseases and insects.
10. Harvesting, grading, and packing.
11. Marketing berries.
12. Keeping records.

Job 1. Determining the Possibilities with Dewberries and Blackberries

Conditions Usually Found.—Commercial berry plantations which are properly managed usually produce profitable returns. Many growers produce these fruits for local markets.

Aims.—The various factors which determine whether or not dewberries or blackberries are profitable should be properly understood before starting to produce them.

Problems for Study and Discussion

1. Make local inquiry to determine the acreage devoted to these berries.
2. What difficulties are local growers having with their berry crops?
3. Give the regions where most of the berry crop in the United States is produced.
4. What types of soil are best for berries?
5. What yields could a farmer expect per acre from dewberries? From blackberries?
6. What is the cost per quart to produce berries?
7. How many years should a berry plantation last?
8. What special labor problems would a grower have in producing berries?

Where Berries Are Produced.—Blackberries are produced in a few southern states in commercial quantities. Texas is the leading southern state for this crop. Many plantations are found along the Ohio and Mississippi Valleys, and along the Pacific Coast.

Dewberries may be grown over a wide range of climatic conditions, but must be protected from severe freezes to prevent injury to the canes. They may be grown in any section of the southern states.

Yields.—Growers who take good care of their plantations may expect to produce from 150 to 175 twenty-four quart crates per acre. The average yields for dewberries and blackberries for the United States would be about half of these amounts.

Prices vary from one season to another, and during the same season. In the early season the berries occasionally bring as much as $8.00 per crate, and later in the season fail to pay express charges. The average price to expect at the farm would probably be about $2.00 to $3.00 per crate of twenty-four quarts. On a good plantation where the proper care is given, the grower should expect approximately $300 per acre in gross returns.

Cost and Duration of Plantation.—The cost of producing an acre of berries will vary much from one section to another and no specific estimate can be accurate. Over a period of years, the cost of producing dewberries and blackberries is usually less than the cost for strawberries. The main difference is the cost of setting the strawberry plants either every year or every few years. If the proper care is given, a dewberry or blackberry plantation will last for many years.

Labor Requirements.—The most of the labor required is for the harvesting. The grower also needs extra labor when setting a plantation. For harvesting fruit he usually has to hire picking crews, which he has to engage well in advance in order to be certain of getting the berries harvested.

Job 2. Choosing Varieties to Plant

Conditions Usually Found.—The best growers realize the need of growing early varieties in the southern states because of market conditions.

Aims.—The different kinds and varieties should be considered and those selected which will best meet the local conditions.

Problems for Study and Discussion

1. Determine which varieties are preferred by local growers.
2. What factors should be taken into consideration in selecting a variety?
3. Why is it best to select a tried variety?
4. Make a list of the best varieties of dewberries.
5. Make a list of the best varieties of blackberries.

Activities.—Collect catalogs and make up a note book with descriptions and illustrations of dewberry and blackberry varieties.

Blackberries vs. Dewberries.—These two types of berries thrive under about the same conditions. Choice between them is usually a matter of market demands, and of personal preference. Many growers plant some of both.

Varieties of Dewberries.—The variety to select is one which will produce well in the locality and one which can pollinate itself. There are certain varieties which have imperfect flowers. Such varieties are seldom used for planting a commercial field.

Lucretia (Fig. 181) is probably the most popular commercial variety. Mayes is a variety often grown in home gardens, and is used for commercial plantations in Texas. Youngberry and Camaron are new and promising commercial varieties.

Varieties of Blackberries.—There are a number of different types of blackberries, so far as canes and blossoms are concerned. Early Harvest is the leading variety for the South. It is susceptible to rust disease, however, which is a very serious objection. In the dry sections the McDonald variety is grown to some extent. This variety is a hybrid of the blackberry and the dewberry; but it is a poor pollinator, and should be grown with other varieties.

Other varieties include Eldorado, Snyder, Taylor, Erie, Ward, Himalaya, and Ancient Briton. The mid-season and late varieties compete with wild berries on the markets.

Job 3. Selecting the Soil and the Location

Conditions Usually Found.—These fruits are usually given good locations by the best growers. Some growers fail to give the proper consideration to soil selection.

Aims.—Soils, proper location of the plantation, and the exposure should be understood by all growers.

Problems for Study and Discussion

1. What is the best slope for dewberries and blackberries?
2. What other factors should be considered in selecting the location of the plantation?

3. What types of soil are best for dewberries? For blackberries?
4. How may the variety affect the selection of the proper kind of soil?
5. Determine the kinds of soil used by commercial growers in your region.

Soils for Blackberries.—This crop will grow on almost any type of soil; but profitable crops will seldom be produced on soil that lacks humus and moisture. The McDonald variety is best for dry soils. The best soil is a deep, sandy loam soil filled with plenty of humus. Moisture must be plentiful, especially during the fruiting period.

Soils for Dewberries.—The best soil for dewberries is a well-drained sandy loam with a clay subsoil. The dewberry, however, will produce on a variety of soils. Even the poorest sandy soils may produce profitable crops if some humus is supplied; but the life of the plants will be short. Moisture is needed in large quantities during the fruiting season. This is likely to be scarce in the lightest soils; hence the need of a heavier subsoil. Choose fields which have grown crops to be turned under as green manure.

Kind of Slope.—The site for a blackberry or for a dewberry plantation is best on a slope away from the prevailing winds. Winds injure the fruit by drying it, and by blowing sand into the berries.

If possible, in the selection of the site there should be taken into consideration atmospheric drainage. If located on a slope, the blossoms will be better protected from late spring frosts.

Location of the Plantation.—Other things being favorable, the plantation should be located near a public road and near the shipping point. Fruit may be injured if it has to be hauled several miles over rough roads.

Job 4. Propagating and Buying Plants

Conditions Usually Found.—Most growers propagate plants successfully when they have a plantation. Plants are usually purchased from a nurseryman for the first planting.

Aims.—The methods of propagation should be understood. Students should also know where and how to purchase plants.

Problems for Study and Discussion

1. How are dewberries propagated?
2. Describe the best method.
3. How are blackberries propagated?

4. At what prices should plants be secured?
5. Find where you can secure plants, and obtain prices.
6. Debate: Propagating vs. buying plants.

Activities.—Practice the propagation of each of these fruits.

Propagating Dewberries.—These vines may be propagated by root cuttings or by tip layering. The latter method is the one usually practiced by growers.

In tip layering, the ends of the young canes are covered with soil during the summer months, and by late fall the new plants are ready for transplanting. The ends of the canes are cut off a few inches above where the tip has rooted. The new plants are taken up as soon as the leaves fall.

Root cuttings three inches long may be made during the winter months and packed in moist sand. The next spring these cuttings are planted in rich soil and are ready to be transplanted by the following fall. Since this plan takes longer than for tip layering, root cuttings are seldom used.

Propagating Blackberries.—The plants may be propagated by root cuttings or by suckers. By digging the roots in the fall, they can be cut into pieces about three inches long. These are stored in a cold place in wet sand to callous until early spring. At planting time the cuttings are set horizontally or dropped in furrows and covered three or four inches deep. This method is the one used by most growers for propagating blackberries.

New canes, called suckers, come from the roots of blackberry plants and from the crowns. These suckers which are sent up at various distances from the crown or parent plant may be dug and planted. Care should be exercised in moving them.

Obtaining Plants.—It is usually best to secure plants from a local grower or from a nurseryman. Root cuttings may be shipped a long distance, but suckers of blackberries are best when they can be reset the same day they are dug. Select plants from healthy plantations only.

Job 5. Preparing the Soil for Planting

Conditions Usually Found.—Most growers prepare the soil well before setting a field to berries.

Aims.—The value of good soil preparation and economical methods should be understood.

Problems for Study and Discussion

1. At what season of the year should the land be prepared?
2. How deep should the soil be plowed?
3. Explain the value of several harrowings after plowing.
4. Under what conditions would you roll the soil?
5. How are rows laid off?
6. What methods of soil preparation are used in your community?

Activities.—In the shop repair and sharpen tillage implements.

Preparing the Soil.—Select a field which has been farmed for several years, or which has grown crops in a regular rotation and has a good green manure crop to turn under. Dewberry or blackberry plantations need deep plowing preparatory to establishing the planting. This is usually done with a heavy turning plow. Berry plantations are maintained for a number of years, hence good preparation is essential. Before the berries are planted the soil is well disked and harrowed several times. Rolling is most advisable to pack light soils or other soils where heavy growth has been plowed under. Rolling with a rough roller helps hold moisture where the roots can use it.

Marking Rows.—A turning plow may mark rows and prepare them for setting the plants. A marker may indicate the distance between plants. Setting will then be very rapid.

Job 6. Setting and Training the Plants

Conditions Usually Found.—Inexperienced growers often fail to set the plants properly, and some space the rows too closely. Experienced growers usually set and train plants correctly.

Aims.—The methods of setting the plants, the distances between rows and between plants, and the methods of training and pruning must be understood.

Problems for Study and Discussion

1. What methods are used for planting blackberries?
2. How does this practice differ from the methods used for dewberries?
3. What are the best distances for each of these fruits?
4. How many plants of each are needed to set an acre?
5. What time of year is best for setting plants in your climate?
6. What pruning is needed for each of these fruits?
7. How are the canes trained?

Activities.—Build a wire trellis and make stakes. Compare by testing two methods of training.

Distances for Blackberries.—Blackberries are usually planted in the South according to two methods. (1) Plants may

be set in rows; or (2) plants may be set in squares, five by five feet or six by six feet.

The distances for setting dewberries depend upon the system of training to be used. If the vines are to be tied to stakes, the plants are set in squares about five by five feet. If a wire trellis is to be used for training the vines, the rows are spaced about five feet apart with the plants from two to three feet apart in the rows.

Methods of Training Blackberries.—Some growers do not use any supports for blackberry plants, but many use different

Fig. 182.—Lucretia dewberries with each plant trained to a single stake. The setting is three feet apart in rows and five feet between rows. New Hanover Co., N. C. (Atlantic Coast Line Ry.)

kinds of wire trellises. The canes may be supported with posts and one wire; or several wires may be used as shown in the figure for dewberries. These supports pay for themselves by increasing the amount of fruit and by making it more convenient to pick.

The vigorous upright varieties are tied to the wires. The varieties which have vine-like tendencies are trained along the wires.

Methods of Training Dewberries.—The most common method of training dewberries is by the stake method (Fig. 182). Stakes about two or three inches square and six or seven feet long are placed in the ground about two feet deep, near each plant. The vines of each plant are gathered together and

twined around the post and tied. The vines are tied in at least two or three places.

Another method of training dewberries is on a wire trellis (Fig. 183). Posts are set at intervals of about one rod. Two wires are commonly used, the top wire being about five feet from the ground and the other two or three feet from the ground. Vines are twined and tied to these wires, enough for good support.

How to Prune Blackberries.—The fruit of blackberries is produced on canes which were produced the preceding year.

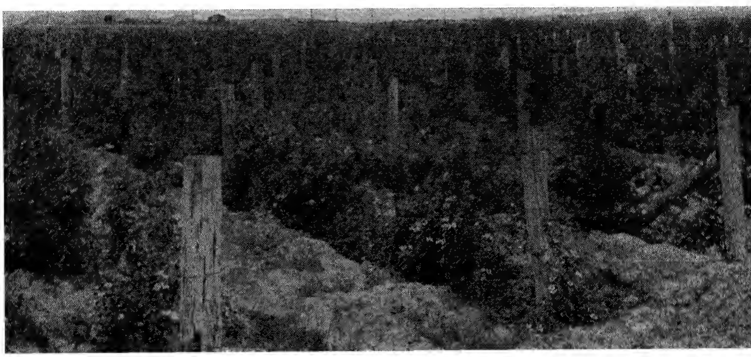


FIG. 183.—Wire trellises are here used for training dewberries. The end posts should be well braced.

The canes grow from the crown, or from the roots, in the spring and summer. The following season these canes produce fruit on short shoots. After fruit is produced the old canes gradually dry up and die.

These old canes should be removed immediately after the fruit is harvested. This gives the young canes a chance to develop properly. Burn the old canes as they are removed to help control diseases and cane borers. Annual pruning in the South may be done immediately after the harvest by mowing down all the growth of the previous year. Select four or more young canes for each plant and prune away all the others. After these reach a suitable height they should be topped with a grass-hook to cause branches to form. This gives more bearing surface for berries.

How to Prune Dewberries.—Dewberries also produce fruit on vines which grew the season before. Pruning is done just after the fruit is harvested by cutting all old canes off near the ground with a brush scythe or with long-handled shears. All of the prunings are removed from the field and burned. The field is then fertilized and cultivated and the young vines allowed to run on the ground. The following spring the vines are tied up just before the blooming period.

Job 7. Providing Plant Food; Applying Fertilizer

Conditions Usually Found.—Growers find that liberal applications of plant food are essential.

Aims.—How to supply organic matter and commercial fertilizers should be understood.

Problems for Study and Discussion

1. What plant foods are deficient in poor soils?
2. When should the larger quantities of commercial fertilizers be applied?
3. At what time would you apply most of the nitrogen?
4. How many applications are made?
5. Find the common fertilizer mixture used in your community.
6. How many of the local farmers use green manure or barnyard manure?

Green Manures.—Some plan should be followed by which organic matter may be added to soils each year. Top dressing of manure may be disked into the soil. Green manure may be grown each winter and disked in or plowed under each spring.

Fertilizing Dewberries.—When dewberries are planted on poor soils, liberal amounts of plant food are required to produce profitable crops. Poor soils may be deficient in nitrogen, phosphorus, and potash.

The common practice is to apply most of the potash, phosphoric acid, and a little nitrogen in the early spring just after the vines are tied to their supports. After the fruit has been harvested and the vines cut, a second application of fertilizer, consisting mostly of nitrogen, is broadcast over the rows. The first application is given to produce a good crop of firm berries, while the second application is given to produce vines and storage matter for the following crop.

Fertilizing Blackberries.—When growers plant blackberries on fertile soil they do not need so much fertilizer as dewberries. Some growers do not use any commercial fertilizer, while others give at least one liberal application. Barnyard manure is often

used at the rate of 10 to 15 tons per acre. Commercial fertilizer may be applied at the rate of 500 or 600 pounds to the acre. The mixture used varies in different sections. This may be applied as given in the preceding paragraph for dewberries.

Job 8. Cultivating the Plantation

Conditions Usually Found.—Many growers fail to give berry plantations the proper cultivation. Neglect is too common.

Aim.—The value of systematic cultivation should be understood by all growers.

Problems for Study and Discussion

1. Compare the uses of a disk harrow and an adjustable cultivator for berry fields.
2. How often should berries be cultivated?
3. Give reasons for cultivating dewberries during the fruiting season.
4. Describe an annual program for the tillage of blackberries.
5. How may a winter cover crop be incorporated into the soil between rows not trellised?
6. How is this done between trellises?

Cultivating Dewberries.—The first year, soon after the young plants are set, cultivation should start. This should be continued during the growing season. Under no circumstances should the young plants be left to compete with weeds and grass.

The second year the berry field should be cultivated shallow or disked four or five inches deep, just after the vines are tied up in the early spring. Cultivation should then be continued at frequent intervals, as during the first year.

It is very important to conserve moisture and control weeds; hence light cultivation should be given after each heavy rain when the soil becomes dry enough. Trellises prevent the use of a disk harrow unless the spaces are wide.

Cultivating Blackberries.—The cultivation is similar to that of dewberries. The first tillage should be done in the early spring and this followed by frequent cultivation between rows until harvest time. If the cultivation is deep, the number of suckers will be increased. Cultivation to control weeds is very important with some growers. After harvest is over and the vines have been mowed down and burned, the crowns and the whole area may be run over with a disk harrow. This question-

able practice is thought to help destroy disease spores and insects and kill weeds. Tillage between rows should continue until about frost time.

Job 9. Controlling Diseases and Insects

Conditions Usually Found.—Growers are bothered with anthracnose, rust, and double blossom. Some insects are sometimes serious.

Aims.—Growers should know the characteristics of the diseases and insects injurious to berries and should understand methods of control.

Problems for Study and Discussion

1. How much damage is done by anthracnose to the berry crop in your region?
2. Describe how this disease damages dewberries and blackberries.
3. Give methods for controlling anthracnose.
4. What is double blossom in dewberries? Describe and give remedy.
5. Give control measures.
6. What other diseases are found in your locality?
7. Describe attacks of rust. Suggest control.
8. Find what insects damage these fruits.
9. Describe and give control for sawflies.
10. Describe attacks of cane borers and of crown borers.
11. Give control measures for these.
12. Give the cause and effect of crown gall.
13. Give control measures.

Anthracnose of Dewberries and Blackberries.—This causes spotting on the canes, which is readily recognized. The spots are small at first and become larger. When spots run together elongated areas are formed. Cracking may follow the drying of the canes. Death occurs at the ends of the canes first. Girdling effects are noticed toward the base of the diseased area. Leaves and fruit are also attacked. In Tennessee and the cooler parts of the South the disease is more serious on raspberries than on blackberries and dewberries.

Treatment consists in spraying with lime-sulfur or Bordeaux; pruning and burning affected parts; cultivation and fertilizing; removal of weeds and rubbish; and admission of sun and air. In the warmer climates this disease has caused growers to mow and burn all canes just after harvest to remove all infected canes. The new growth shows little if any anthracnose. Newly set places should be rogued carefully the first year.

Orange and Cane Rusts.—Several related rusts attack blackberries. Orange rust (Gymnoconia interstitialis) is most common, appears on leaves earlier, and is darker in color than the

cane rust (Kuehneola albida). The latter continues later in the summer.

Dig out and burn plants affected with orange rust, as the fungus is systemic, occurring on the roots also. Cane rust seldom attacks the roots, and mowing or pruning off the canes to be burned is sufficient. Never plant nursery stock started from affected plants. New plantings should have affected plants rogued out carefully. The most resistant varieties of blackberry are Snyder, Evergreen, Lawton, and Eldorado, which are rarely attacked by orange rust. Lucretia and Young are dewberries resistant to rusts.

Crown Gall.—This trouble is caused by gall-forming bacteria which attack the crowns and roots of blackberries and dewberries. Galls and swellings appear on the roots of the plants.

Detecting affected stock from nurseries is important. Avoid planting on soils infested with the trouble. Any crops affected with similar troubles may leave the soil infested. No known remedies of practical value have been discovered. Affected plants should be dug up and burned. Watch closely for the galls when pruning and disking the crowns. If they are kept for another crop or two they should receive heavy applications of nitrogenous fertilizers to stimulate healthy growth.

Double Blossom.—This disease is found most in dewberries and especially in the Lucretia variety. Some of the stamens develop into petals. It may be noticed even before the blossoms open, by the enlarged diseased buds. The blossoms open and show flowers of a great variety of deformities. The fruit from such blooms never develops properly and is worthless. Pruning the diseased canes and burning them is the most effective control measure practiced.

Cane Borers.—Two types of cane-borer attack blackberries and dewberries. The American longhorn beetle is the adult of the one most commonly found. Young growing canes are attacked by the adult laying eggs in the pith. To do this, the female makes two rows of punctures around the cane, half an inch apart. This causes the tips of the canes to wilt.

As soon as the wilting is noticed, the affected parts should be cut away and burned. If this is not done, the borers work down the canes and do much more damage through a period of

two years. The beetles emerge in May or June after the two-year cycle. Thorough annual pruning will destroy cane borers completely if the canes are burned.

Red-Necked Cane Borer.—The red-necked cane borer causes irregular swellings or galls on the new canes of blackberries and dewberries. The infected canes either die or are weakened and fail to produce. Removal and burning of all infected canes during the fall will control this pest.

Crown Borers.—In this case the adult is a moth which lays eggs on the leaves of the plants in late summer and early fall. When the larvæ hatch they crawl into the stems and pass the winter at the base of the canes. This gives them the name of crown borers. They hide in the roots and crowns all summer and pass a second winter in their channels, appearing about midsummer as adult moths. The attacks of this parasite often kill the plants. A sickly appearance of the growth is noticed. Dead canes serve as a warning.

The first remedy is to dig out and destroy the larvæ or to remove affected parts. Rotation of the plantation is also recommended. Thorough pruning by the mowing method for blackberries and dewberries will destroy many of the crown borers. If disking the soil over the crowns follows after mowing the tops, many borers may be destroyed. Larvæ are exposed to the attacks of birds.

Sawflies.—These insects attack blackberries and dewberries. The adult is not a true fly but has four wings and otherwise resembles a fly. Eggs are deposited in spring on the under surfaces of the leaves. When the larvæ hatch they begin eating the surfaces of the leaves and when the soft tissues are gone they attack the young twigs. The damage consists in defoliating the plants and ruining or nearly killing the plantation.

Poisoning the larvæ during the early feeding stage is easily accomplished by spraying with arsenate of lead, using one pound in fifty gallons of spray. If attacks occur very late, hellebore may be substituted to prevent poisoning the fruit. Use one ounce of hellebore to one gallon of water.

Aphids are often serious on these crops just before blooms appear. Spray or dust with nicotine sulfate promptly when the first attack is noticed.

Job 10. Harvesting, Grading, and Packing

Conditions Usually Found.—These crops are usually well harvested by experienced growers. In some cases, the fruit is picked too soon.

Aims.—How to judge the maturity of berries and how to pick, grade, and pack them for market should be understood.

Problems for Study and Discussion

1. How can you tell when these fruits are ready to harvest?
2. What difference is made in time of picking when the fruit is to go to different markets?
3. Describe how these fruits are properly picked.
4. What is the usual price per quart paid for picking?
5. What containers are needed in picking berries?
6. Describe how berries should be handled after picking.
7. To what extent are berries graded?
8. Describe a good type of packing house needed for these crops.
9. Describe containers used for shipping berries to market.
10. How are the berries packed?

Activities.—Assist in harvesting, grading, and packing berries. Make crates similar to the one illustrated.

Judging Maturity.—Dewberries and blackberries usually turn black several days before they are ripe. If the berries are to be shipped to a distant market they are usually picked just after they are well-colored. The flavor of the fruit is never so good, however, as it is if the fruit is allowed to ripen fully before being picked. For the local market the fruit should never be picked until it is ripe.

How to Pick.—The fruit should never be picked in the early morning when it is wet with the dew, nor just after a rain. Berries discolor and spoil quickly if handled when wet. The berries are caught with the thumb and two fingers and carefully removed from the canes. The picker should never keep many berries in his hand as they mash easily. Special care must be taken in placing them in the carriers. Use thin leather gloves with the fingers cut away. Gloves make pickers less afraid of thorns.

Containers.—The pickers in the field each carry a tray with a firm, arched handle and holding four to eight berry boxes (Fig. 184). Both dewberries and blackberries are sold in quart boxes, packed in crates holding sixteen, twenty-four, or thirty-two boxes. The regular strawberry boxes and crates are the common ones used in the South. In a few cases, the pint boxes are used

for the earliest pickings when prices would be too high by the quart.

The Packing Shed.—The type of shed used for packing strawberries is satisfactory for these berries. Sheds are com-

FIG. 184.—Harvesting dewberries in the sandhills of the Carolinas. (Seaboard A. L. Ry.)

monly open on the sides. A second story or loft may be closed for storing crates and supplies.

Grading and Packing.—All the grading necessary is done by the pickers in the field. All diseased or undeveloped fruit should be discarded. At the packing shed the packers see that all the boxes are filled properly and arrange the berries uniformly on the top layer. The boxes should not be filled too full because damage will be done to the fruit when it is placed in the crates. The boxes are packed into crates which are then well nailed and suitably labeled for shipment (Fig. 185).

Job 11. Marketing Berries

Conditions Usually Found.—Few sections have a well-developed system of marketing.

Aims.—Growers should understand the functions of marketing, the different methods of marketing, and problems connected with this job.

Problems for Study and Discussion

1. What is the usual price received for berries?
2. How do local growers market their crops?
3. What are the advantages of coöperative marketing?
4. What is meant by f.o.b. sales?
5. Find to what extent dewberries and blackberries may be sold locally.
6. Ask several growers about the advisability of canning these fruits or of making jellies and jams.

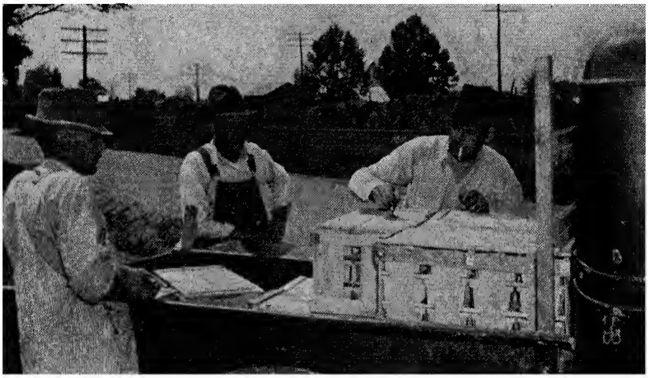


FIG. 185.—The 24-quart crate is most commonly used for blackberries and dewberries. A federal inspector is checking the grade of the farmer's pack. (U.S.D.A. Photograph by Peter Killian.)

Local Marketing.—In many places most of the berry crop is sold in the local market. Each locality will consume a large quantity of these fruits if they are available.

Shipping.—In communities where a large acreage is planted, distant markets must be considered. The fruit is shipped in refrigerator cars with approximately 200 crates to the car.

Three Ways of Selling.—(1) The loaded cars are often sold f.o.b. the tracks to car-lot buyers. This plan relieves the grower of much of the marketing risk. (2) They may be consigned to commission merchants in various cities, in which cases the grower assumes all risks. (3) Where berries are extensively grown, the

individual growers would probably profit by organizing a co-operative marketing association. Such an organization can better standardize, advertise, and market the fruit.

Job 12. Keeping Records

Berry records should be carefully kept on such forms as those given in the Melon Enterprise. Special records should be kept on all points regarding varieties, diseases, and markets. Fill a trial set of blanks, using reliable data from growers.

Station Bulletins.—Get lists of available bulletins from each of the state experiment stations of your region. Order from these lists the most valuable bulletins on dewberries, blackberries, and raspberries. Each student should build up a home library and keep it in his study or office. Be sure to obtain bulletins on blackberries and dewberries from the stations in California, Florida, Texas, and others.

Dewberry and Blackberry Calculations.—1. A young man propagated dewberry plants and set them in permanent places at a cost of $45 per acre, setting them 5 x 5 feet. Find his saving if plants could be bought for $4.50 and set for 25 cents a hundred.

2. The same young man grew spinach between the rows. By charging one-fourth the cost to the berry plantation he cleared $40 on sales amounting to $100, the buyer supplying the crates. Find the year's costs and the amount charged to berries.

3. The next year he set a stake for each berry plant, paying 3 cents each for stakes and setting them at a cost of 1 cent each. Find the cost per acre for stakes and for setting.

4. If blackberries can be propagated at half the cost of dewberries, and if by close pruning no supports are necessary, find from the results of the preceding problems the savings the first 2 years from growing blackberries instead of dewberries.

5. To overcome the difference found in problem 4 in the first 3 crops of berries by larger yields, how many more crates per year must dewberries yield if they net a uniform price of $2.50 per crate?

6. A student produced 110 crates of 32 quarts each on an acre. He sold the crop at an average price of $2 per crate. What was his average income per quart?

7. An acre of dewberries produced 145 32-quart crates which sold for an average price of $2.25. The cost of producing the berries was $100 up to the time of harvesting. Three cents per quart was paid for picking. Secure the local price for crates and determine the profit per crate. What profit was made per quart?

8. If each dewberry plant requires ¼ pint of spray material, how many gallons of Bordeaux mixture are needed to spray an acre where the plants are set 5 x 5 feet? Determine the local cost for the materials needed for making the spray.

Dewberry vs. Blackberry

Dewberry

Suits southern climate
Varieties highly improved
Endures poorer soils
Responds to rich soils
Maturity easier to judge
Picking easier if trellised
Fruit more attractive
Prices often higher

Blackberry

Withstands colder winters
Less pollination difficulty
More varieties to choose
Needs less trellising
Pruning easier if not trellised
Cultivating easier also
Handling fruit less delicate

GRAPE ENTERPRISES

Collaborator: A. M. Musser, B.S., Horticulturist, Clemson Agricultural College, Clemson, S. C.

Analysis into Jobs.—The farm units in a grape enterprise may be considered under the following jobs. References are to U. S. Farmers' Bulletins. Send for State Station Bulletins. See also *American Grape Growing,* by Hedrick (Macmillan).

1. Determining possibilities with grapes.
2. Choosing varieties, 709.
3. Selecting the location and the soil.
4. Propagating grapes; buying plants, 471.
5. Preparing vineyard and setting plants.
6. Supplying plant food.
7. Cultivating the vineyard; intercropping.
8. Training and pruning the vines, 471.
9. Controlling insects and diseases, 1220.
10. Harvesting, grading, and packing.
11. Marketing grapes, 1454, 1558, 656D, 861D.
12. Keeping records, 511, 572, 782, 1182.

Job 1. Determining Possibilities with Grapes

Conditions Usually Found.—Commercial grape growing is found in special regions. Some of these are gradually expanded. Grapes are grown for home use and local markets in every state.

Aims.—The soil, climate, yields, markets, and other factors in grape growing should be understood.

Problems for Study and Discussion

1. What are the climatic requirements of grapes?
2. Where are most of the grapes produced in the United States?
3. Compare the range of temperature and the rainfall of the successful grape regions of the United States with those of your section.
4. What winter temperatures will the grape stand?
5. What is the likelihood of loss resulting from excessive rains during fruit ripening?
6. What are your competing sections?
7. How does your section compare with these competing sections in suitability for grapes?
8. What is the average cost per acre in other sections and how does the cost per acre in your section compare with this?
9. What is the average yield per acre in other sections, and how does this compare with the yield per acre in your section?
10. What length of time is necessary to bring a vineyard into profitable bearing?

11. What is the profitable life of a grapevine?
12. How many commercial vineyards are found in your community?
13. What is the average price per pound in other sections for grapes of the type suited to your section?
14. How many acres of grapes can one man handle?
15. How much help must be hired and in what jobs will this be needed?
16. How many acres of bearing vineyard, ripening together, will be necessary for daily loading of cars?
17. Determine whether or not the natural advantages of your section warrant the planting of more vineyards.

Activities.—From the latest U. S. Yearbook of Agriculture make three tables on a chart: (1) prices for the last six years; (2) production for last six years; (3) yields for the last six years. In each case compare the first three with the last three years.

Relation of Climate to Grape Growing.—Grapes are reported as growing and producing to perfection under climatic extremes, but favorable climate gives better yields and is therefore important. According to Hedrick, a recognized authority on grape-growing, six climatic factors must be considered: (1) length of season; (2) total sum of heat for season; (3) amount of humidity in summer weather; (4) dates of spring and autumn frost; (5) winter temperature; (6) air currents.

Excessive moisture, either in the air or soil, makes conditions unfavorable for grape-growing. Moist weather during the setting and ripening of fruit results in decreased crops, in poor bunches of fruit, and in fungous diseases. Sections subject to "blankets" of fog should be avoided.

Grape Regions.—Grapes are grown for home use in every agricultural section of the United States and Canada. Commercial production has been largely confined to special regions. The western region, including California, grows 85 per cent of the crop. The Great Lakes region, including New York and Michigan, stands second in importance. The southern states grow less than 1 per cent of the crop.

Within recent years grape growing has attracted attention in the mountainous and hill sections of the Alleghanies and southward, and in the Ozark region.

Grape Production in Southern States.—The annual production in tons of grapes in the southern states is shown in the following list arranged in order of production:

Arkansas	8430	Texas	2300
North Carolina	6150	Tennessee	2250
Oklahoma	2750	Kentucky	2030

Virginia	1930	West Virginia	1175
Georgia	1690	Florida	635
South Carolina	1340	Mississippi	350
Alabama	1280	Louisiana	100

Competing Sections.—Harvesting and shipping of other states should be considered. The following list of approximate shipping dates makes a study of competing regions possible.

States	*Approx. Shipping Dates*	*States*	*Approx. Shipping Dates*
Arizona	June 25 to Aug. 25	Michigan	Aug. 15 to Nov. 3
Arkansas	July 30 to Aug. 27	Missouri	Aug. 5 to Sept. 18
S. Calif.	June 15 to Dec. 1	Nebraska	Aug. 5 to Sept. 27
Cen. Calif.	July 15 to Nov. 15	New Jersey	Sept. 1 to Nov. 1
N. Calif.	Aug. 1 to Dec. 1	New York	Aug. 15 to Dec. 1
Delaware	Aug. 15 to Sept. 28	Ohio	Sept. 1 to Nov. 15
Iowa	Aug. 25 to Sept. 28	Pennsylvania	Sept. 1 to Dec. 1
Kansas	Aug. 10 to Sept. 15	Washington	Sept. 1 to Nov. 1

Yields per Acre.—The following are average yields of grapes per acre as reported by successful growers: 28 months, 1,000 to 2,000 pounds; 36 months, 1,500 to 4,000 pounds; 48 months, 4,000 to 6,000 pounds. The fourth year, from one acre yielding 5,000 pounds of grapes, selling at six cents, the returns would be $300. The cost of picking, packing, and marketing would be about $90, and the fourth year's care of the vineyard $160, giving a net profit of $50.

The costs per acre the first year with American bunch varieties varies from about $190 to $348 in different sections. Land and labor vary more than plants. The costs for the first year may be fully returned or in part from intercrops.

Good prices depend upon quality of product, earliness, and the absence of competition. The prices received by shippers in large markets for a five-year average were 70 cents per twelve-quart basket.

Labor requirements are greatest at harvest season and during the fighting of diseases. With extra help during harvest and sometimes during spraying, one man should handle twenty to twenty-five acres of vineyard.

Acreage Needed to Load Cars.—The individual grower or the community pool should have 150 to 200 acres of a variety to make possible the loading of cars daily during the shipping season.

Job 2. Choosing Varieties

Conditions Usually Found.—The number of successful commercial varieties is rather limited and markets are very partial to certain varieties. New types and varieties are not readily salable.

Aims.—The importance of selecting good varieties and which ones to choose for commercial plantings, considering all points, should be understood.

Problems for Study and Discussion.

1. What are the distinguishing characteristics of the two types of grapes grown for commercial use?
2. What other type is not much grown commercially? Describe it.
3. Where are the grapes of these three types chiefly produced?
4. Which type would you choose for home use? For market?
5. What are the characteristics of a good commercial variety?
6. In which type of grapes are flowers usually imperfect?
7. Of what importance is compactness of the bunch and what factors might influence this condition?
8. Prepare a list of varieties according to (1) ripening period, (2) market qualities, (3) home use.
9. Report opinions of growers as to which varieties have proven best for home use; for commercial planting. Give the reasons.
10. Determine how well the varieties grown satisfy the commercial markets.

Activities.—Collect grapes of several varieties. Contest in knowing varieties by sight.

Three Types of Grapes.—According to fruit and clusters, grapes are of three types: (1) European bunch grapes with meaty flesh; (2) American bunch grapes with soft, juicy flesh and slip skins (Fig. 186); (3) Muscadine grapes growing in small clusters.

Grapes of the European group are commonly grown in California, and are familiar in all markets. Most dessert and raisin grapes belong to this group. The scientific name is *Vitis vinifera.*

The native American bunch grapes and their hybrids are traceable to a number of different species. They constitute our chief market grapes, grown east of the Pacific region. The pulp and skin of the grape separate easily with slight pressure. They are abundantly used as table grapes, for marmalade, grape juice, jellies, and, to some extent, wine.

The Muscadine grapes are native of the southern region. They vary in color from black to white. The clusters vary in number of berries from three to twelve or sometimes eighteen. There are

a number of named varieties, such as Scuppernong, James, Thomas, Memory, Flowers, and Hunt. These belong to the species *Vitis rotundifolia.*

Concord.—A leading blue bunch grape for eastern markets is Concord. It yields well, is popular, and is fairly resistant to diseases. It does best

FIG. 186.—Bunch grapes prove a profitable crop in many sections of the South. (Seaboard A. L. Ry.)

in high altitudes such as the Alleghanies and Ozarks. It ripens somewhat irregularly in lower altitudes of the southern region.

Moore's Early.—This variety is purplish black and looks much like the Concord, but ripens earlier. It is not a vigorous grower and does not produce large crops. It is a poor shipper and cannot be held as long as the Concord. It is popular in some sections for local markets and for home use.

Niagara.—This is a yellowish green or white grape with bunches as large as the Concord, and ripening a little earlier. It is the leading American bunch grape of this color and sells well in large markets.

Delaware.—The bunches are small and compact. The berries are bright red and have high quality. They ripen about the season of the Concord, or a little earlier. They are the most popular red grapes in large markets.

Munson.—The color is black; ripening is in mid-season. It is not commonly found in large markets. The blossoms need cross pollinating. The root is strong and the vines endure the dry winds of the southwest.

Extra.—This is of the blue to blue-black type and ripens in mid-season or later. The bunches are compact when grown in some sections, as at Clemson College, S. C. It is not yet well known on the markets.

Other Red Grapes.—Brilliant is early and good for local markets. Beacon and Ellen Scott are mid-season. The Ellen Scott produces large bunches of thin-skinned berries. Carmen is too late, except for the Gulf sections. The quality is poor but the berries keep well. Herbemont is also very late and is subject to black rot in some sections.

A Good Commercial Variety.—A variety may be a complete failure in one section and successful in another section. Such conditions are due to such factors as climate, elevation, market demand, and market competition.

For commercial use, the variety should yield well; resist disease; have good carrying quality; and suit the market in quality and ripening. A self-sterile variety or one with imperfect flowers should generally not be selected for commercial planting, because poor crops or loosely formed bunches will often be the result. Compactness of bunches is of much importance and is largely the direct result of good "setting" of fruit.

Varieties for Home Nearby Markets and Vineyards.—For South Carolina and like climate and conditions, the following, arranged in order of ripening, are suitable for home vineyards: Moore's Early, Lucile, Niagara, Delaware, Bailey, Extra, Florida Beacon, Concord, and Catawba.

Job 3. Selecting the Location and the Soil

Conditions Usually Found.—Home plantations are scattered and often not well located. Commercial vineyards are more commonly carefully located as to site and soil.

Aims.—Students should understand the problems involved in properly choosing sites and soils for grapes.

Problems for Study and Discussion

1. Ask grape growers to state what points they consider most important in locating a large vineyard.
2. Show the importance of locating vineyards handy to a loading station.
3. Show the value of other vineyards near your station.

4. Discuss the value of locating the vineyard near a good road.
5. Compare different soils for your region for vineyards.
6. After what types of crops should grapes be planted on your local soils?
7. Discuss the value of soil drainage for grapes.
8. How important is air drainage for vineyards in your region?
9. What aspect is considered best for vineyards in your climate? Why?

Activities.—Collect samples of soils and subsoils from proposed sites.

Size of Vineyard.—Commercial grape growers in any region should consider the relation of size of the vineyards to making car-lot shipments, and to meeting other market problems. The acreage required for daily loading of cars of one variety has been given as 150 acres. One grower may plan to fill a car or more alone, or may coöperate with others. Select a field for planting where the size can be increased if desired.

Transportation Facilities.—Growers should locate vineyards near good roads, as much of the crop may be marketed by trucks, or the crop must be hauled to a loading point. If the shipping station is not far from the vineyard, much expense and time will be saved at harvest time, and grapes will reach market in better condition.

Soils for Grapes.—The grape adapts itself to a great diversity of soils and often produces satisfactory crops for a short time, even when the vines are grown under unfavorable conditions. The different types and varieties make possible the successful growing of grapes under a wide range of soil conditions. Commercial vineyards often succeed on soils too light and poor for some other crops. Soils must be free from root diseases. Light loams are better than heavy soils for grapes. Rather deep, fertile soils with subsoils not too loose enable vines to continue vigorous growth for many years.

Air and Soil Drainage.—The location should be sufficiently well elevated to afford necessary air drainage; should have sufficient slope to insure water drainage; and the water table should not be nearer the surface than thirty or thirty-six inches.

Aspect.—A westerly exposure is usually considered unfavorable for vineyards because of the bad effects of hot winds and sun during the ripening season. Probably an easterly exposure is best in most grape sections. If soils are of the cool type, a southerly exposure would be favorable for earlier growth and development than a northerly exposure. A northerly exposure is seldom preferred but would suit the sandy soils best. Grapes

do not develop early in spring and blossoms are seldom killed by late spring frosts.

Job 4. Propagating Grapes; Buying Plants

Conditions Usually Found.—Most vineyards are planted with vines grown by nurserymen. As plantings increase and experience has been gained, growers often propagate their own plants, or order cuttings and grow them. Buying vines from agents for home planting is still too common.

Aims.—Students should understand the importance of growing or of buying good grape vines. They should know (1) methods of propagation; (2) the best and most congenial root stocks; (3) method of making, handling, and planting grape cuttings; (4) care of the young plants in the nursery.

Problems for Study and Discussion

1. Get local growers to give points on buying and propagating vines.
2. How can cuttings, grafting wood, and stocks be obtained?
3. Explain and demonstrate propagation by cuttings, by grafting, and by layering.
4. Report nursery practices and how plants are propagated, fertilized, and cultivated.
5. What kind of soil should be selected for a grape nursery?
6. Make comparative cost estimates of home-grown and of nursery-grown plants.
7. Under what conditions should grapes be propagated: (a) by root or crown grafting? (b) by cuttings? (c) by seed? (d) by layering?
8. What conditions make grafting of old vines necessary?
9. Make a list of varieties that should be propagated by grafting.
10. Make a list of varieties that are suitable to use as stocks on which to graft.
11. Make a list of varieties that are successfully propagated by cuttings.
12. When, how, and why are grape vines heeled-in?

Activities.—Practice propagating grapes by cuttings, by layering, and by grafting, until you become skillful. Make suitable boxes for storing cuttings.

Methods of Propagation.—Grapes are commercially propagated by cuttings, by layering, and by grafting. The common and most popular methods used in propagating grapes are by cuttings and by grafting. Top grafting and root grafting are both practical but may serve different purposes. Seed propagation is used in originating new varieties. Grafting is resorted to where varieties do not make satisfactory growth and development on their own roots, short-lived own rooted varieties, or when their own roots are attacked by phylloxera, or in working over vines of undesirable varieties.

Complete changes of varieties are seldom made but may be necessary when better varieties are competing in the markets.

If the old variety proves susceptible to disease, grafting with another kind may be best.

Root grafting is used chiefly for propagating varieties which have weak roots and they are grafted better on roots. The cleft-grafting method just below the surface of the soil is commonly used. (See Apple Enterprise.)

Grapes of the Muscadine group are most successfully propagated by vine layering during late summer and at winter pruning time.

The following are those varieties known as having given satisfactory results as stocks in the southern and southeastern sections: Munson, Carman, Florida Beacon (Big Extra), Herbemont, Marguerite, Dog Ridge, Luksfata, Champand, Elvicand, and Lomanto. When a grower is not certain about any variety succeeding on its own roots, this variety should always be grafted on roots of known value.

Making Cuttings.—For best results, cuttings should be made from well-ripened, normally developed wood of the last season's growth (Fig. 187). Wood from bearing vines of vigorous growth is always to be desired. When the vines are dormant and ready to be or are being pruned is the proper time for making cuttings. Make them about ten inches long with buds near the top and the bottom. Each simple cutting should usually bear two or more buds. Tie the cuttings in small bundles of about twenty-five or fifty each, labeling them. Avoid mixing varieties.

Storing.—The bundles of cuttings are packed away in wet sand in a box or in a cutting pit, until ready for planting in nursery rows in the spring. They callous during this storage period. Sometimes in warm climates they are planted in the nursery rows in winter when first cut.

Planting Cuttings.—Soil that is well drained and free from disease and is retentive of moisture, such as is suited to truck crop growing, is suitable for a grape nursery. The soil should be well prepared by plowing and repeated disking. The rows are laid off three and one-half to four feet apart, and the cuttings are spaced approximately twelve inches apart in the rows. The cuttings should be covered to such depth as to have the uppermost bud only slightly above the surface of the settled ground and the soil well firmed about cuttings.

Care of the Nursery.—Time spent preparing the soil well

and keeping the vines thrifty by good tillage reflects itself later in the vineyard when vines are transplanted. Well-grown one-year-old vines are preferred to older vines. A safe and general rule is to keep the vines growing from the time the cuttings have become well established, until late summer. Frequent shallow cultivation is best. No weed growth should be found. Regular applications of nitrogenous fertilizer should be made as side

FIG. 187

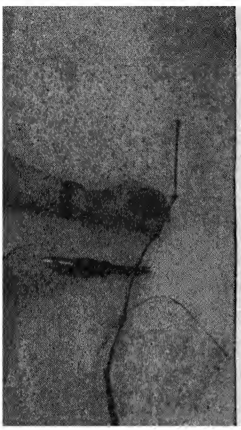


FIG. 188

FIG. 187.—Cuttings are made at the winter pruning time. Save three buds and cut above top bud and below bottom bud.

FIG. 188.—Grape project. Inspecting to determine results of fertilizer trials.

dressings. The most critical period during the early growth of the vines developing from cuttings or grafts is immediately after early spring growth. Careless cultivating may disturb and break root growth and cause the breaking off of buds or grafts.

Cost of a Grape Nursery.—If the cuttings are purchased from a nursery or vineyard, the following items give the approximate cost of growing:

100,000 cuttings at $12 a thousand, if bought........	$1,200
Setting cuttings..................................	75
Cultivating 3 months, 1 man.......................	150
2½ tons fertilizer at $35.........................	87
Digging plants (estimating 50,000 as good)........	500
Total cost of nursery.........................	$2,012
Total cost per 1,000 vines, 4c each...........	40.24

The above cost per vine is much lower than the price charged by nurseries. Inexperienced growers may not succeed as well as these figures indicate and buying the vines may be more profitable for such persons.

Buying Nursery Vines.—Well-grown one-year-old vines with strong tops and roots should be selected. Avoid patronizing agents. Deal only with reliable nurserymen. Visit the nursery if possible. Consider quality and not price alone. Examine vines after they are dug, as roots are as important as tops. Place orders early; if possible, two months before the vines are needed. Calculate the vines needed per acre by rule in Appendix.

Care of the Vines.—The vines should be unpacked immediately after arrival and, with as little exposure as possible, the roots should be covered in a trench. This method of protecting nursery stock is known as "heeling-in."

Job 5. Preparing Vineyard and Setting Plants

Conditions Usually Found.—Commercial growers realize the value of careful preparation of soil before planting. The layout is carefully planned and vines are set carefully. For home use more careless methods are often followed.

Aims.—Growers should understand the methods and need of careful preparation and planting.

Problems for Study and Discussion

1. Find how the farmers in your community prepare soil, lay out the vineyard, and set the vines.
2. In what cases are vineyards set on old land? On new land?
3. At what different distances are vines set in your region? Give reasons for variation.
4. How is the soil prepared for planting if a cover crop has been grown on the field?
5. How is the soil prepared for planting if recently cleared of timber?
6. Give directions for digging holes for vines.
7. Give directions for setting vines carefully.
8. Discuss depth of planting.
9. Under what conditions is watering advisable? How and when is watering done?
10. Describe the work of a planting crew and estimate cost of planting.

Activities.—Assist in staking out a vineyard. With leveling instrument and target pole run level lines for grape rows on a hillside. Practice digging holes and setting vines.

Preparing the Soil.—Thorough preparation should be given before planting a vineyard. Extremely deep plowing is not recommended if the top soil is shallow. The soil should be disked

after plowing and one or more harrowings may be necessary to keep down weed growth before planting.

Laying Out the Vineyard.—The rows should be marked out, if possible, in such direction as to prevent damage from prevailing winds. If the area is sloping, the rows should be wider apart up and down the slope, so that the annual cultivation will be around the hill. The most popular spacing of vines is eight by ten feet. The ten-foot space, in that case, is used for most of the cultivation, and for driving sprayers and harvest trucks. The trellises run parallel to the ten-foot spaces. Allow room at the ends of the rows for turning. Slow-growing vines on poor soil are set closer. Vigorous varieties require greater spacing.

On a hillside, stake a central row approximately on a level around the hill and then stake off the other rows parallel to this. In a level field, stake the two adjacent boundary rows first and then measure all other rows from these.

A turning plow may be used in laying off the rows in one direction. This makes less hand work in digging the holes, which should be made deep enough to allow replacing of some of the top soil in the bottom. Vines should be set a little deeper than they grew in the nursery. Make holes large enough to avoid crowding or folding the roots.

Pruning at Setting Time.—Grape vines should be planted before buds swell in the spring, and before sap begins to flow. The winter months are best. Large roots should be shortened. The top should be pruned to a single short stub having two or three good strong buds.

Setting Vines.—Handle the vines with the least exposure to sun and air. They may be covered with wet burlap bags or immersed in tubs of muddy water. Distribute only a few ahead of the setting.

Effects of Terracing

Checks erosion of soil
Catches best surface soil
Saves soil fertility
Prevents burying lowlands
Controls the water flow
Distributes water more evenly
Increases capillary moisture

A boy may place the roots in the hole and hold the vine in the proper position while soil is thrown in by a workman, and then he may tramp the soil thoroughly on the roots. The holes should be filled level unless water is applied. Watering is advisable in dry times but it is otherwise not necessary.

Job 6. Supplying Plant Food

Conditions Usually Found.—Growers vary widely in their practices in fertilizing vineyards.

Aims.—Growers should understand the plant-food needs of vines and know how to supply these needs.

Problems for Study and Discussion

1. What plant foods are deficient in your local soils?
2. Report practices of growers regarding fertilizing of vineyards.
3. What types of soil are most deficient in nitrogen? In potash?
4. How does home mixing aid in supplementing soils deficient in one or two elements?
5. Compare the needs of a young vineyard with the needs of a bearing vineyard.
6. Compare the costs in the two cases.
7. Discuss rates of application.
8. Give rules regarding the number and times of application of fertilizers.

Activities.—Collect samples of vine growth showing the influence of fertilizers (Fig. 188). Mount these on wood-pulp board.

Fertilizing Young Vineyards.—When grape vines are young they require considerable nitrogen to produce vigorous growth. Heavy soils may supply enough plant food. On medium or light soils turn under heavy growths of green manure, or use an abundance of barnyard manure. If commercial fertilizer is used it may be supplied in the form of sulfate of ammonia or nitrate of soda, using two or three hundred pounds per acre.

If the soil is sandy, balance the nitrogen with fifty pounds of muriate of potash per acre. During the last half of the second year in the vineyard two hundred pounds of superphosphate per acre may be used at two applications, beginning in June. This should aid in producing a better crop of grapes the third summer.

Fertilizing Bearing Vineyards.—Phosphoric acid is essential for production of fruit. Bearing vines require a balanced fertilizer. A good formula is 5-8-5 (N-P-K). Raw bone meal at

the rate of one-half pound or more per vine or as much as 500 pounds per acre is often used. Another plan is to use 200 pounds each of nitrate of soda, superphosphate, and kainit. If a cover crop is worked into the soil as a green manure each year, the nitrogen may be reduced in the commercial fertilizer. Heavy soils may require less fertilizer than do the lighter soils.

Methods of Fertilizing.—In young vineyards, as well as in bearing vineyards, fertilizer may be spread by hand about eighteen inches from the vines. As vines grow older the fertilizer should be spread farther. This should be worked into the soil with a cultivator or harrow.

Times of Application.—On light soils young plants should be fertilized early in the season. A second application can be made a few weeks later. If winter cover crops are sown each year in late summer, it is impractical to apply fertilizers after sowing the seed. Bearing vines should have the nitrogen, phosphoric acid, and potash applied early in the season. When heavy commercial fertilizing is practiced, two or three applications are better than one.

Job 7. Cultivating the Vineyard; Intercropping

Conditions Usually Found.—(1) Commercial vineyards are usually better cared for than others. (2) Home vineyards are often not cultivated at all.

Aims.—The reasons and methods of intercropping and good methods of cultivation should be well understood.

Problems for Study and Discussion.

1. Report the annual plan of cultivating the vineyards recommended by the best grape growers.
2. What intercrops are grown in vineyards in your region?
3. Suggest the best crops for growing in young vineyards.
4. For how many years should these crops be grown? Why?
5. Debate: Clean cultivation vs. sod for vineyards on hillsides.
6. Compare results in two vineyards handled by these two methods.
7. How long would you continue cultivation between rows each season if a winter cover crop is to be grown?
8. When should a winter cover crop be turned under?
9. How frequently would you till the soil after turning under the winter cover crop?
10. What implements would you recommend for this work?
11. Discuss the relation between cultivation and the work of tying up the canes.

Activities.—Plant different cover crops and different intercrops between rows of vines and compare the results. Compare two different sys-

tems of cultivating in a vineyard. In the shop, put tillage implements in good shape for use.

Cultivation in Young Vineyards.—During the first two years the cost of cultivation may be balanced by returns from intercrops grown between rows. Tillage should be thorough and frequent. No weeds should appear. Before the winter crop is planted a disk harrow may be used between rows each season.

Intercrops.—Review the intercropping system recommended for peaches. Suitable crops are those which grow in early summer but not in early spring. Bush beans, peppers, and eggplant meet the requirements. Only one or two rows should be grown in each middle. Never grow intercrops after the second summer.

Cover Crops.—Crimson clover, Austrian winter peas, vetch, or peas and vetch in combination, or rye in very fertile soils may be sown between rows in late summer or early fall, to remain as a winter cover crop until early spring. This plan is suitable for vineyards on hillsides as well as others. It suits both young and old vineyards. Avoid sowing seed in the rows, as hand work may be needed to clean out the rows in the summer. The cover crop prevents erosion and leaching during the winter and provides green manure each year.

Cultivating Bearing Vineyards.—Each spring, after the winter cover crop is plowed under or disked in, the soil should be kept disked or harrowed and kept free from weeds until time for resowing the winter cover crop. (Fig. 189.)

Job 8. Training and Pruning the Vines

Conditions Usually Found.—In many cases home vineyards are badly neglected. Commercial vineyards are usually pruned annually and well supported with trellises.

Aims.—Economical methods of trellising and pruning of grapes should be well understood.

Problems for Study and Discussion

1. Report what annual pruning is done by local growers.
2. Get reasons for and against pruning a home vineyard.
3. Compare examples of good pruning with others of little or no pruning.
4. Explain the natural method of bearing grapes which allows the grower to prune away much of the old growth of canes.
5. Give directions for pruning grapes to be trellised by one of the Kniffin systems.
6. When should pruning of grapes be done? Why?
7. Describe the Munson system of trellising.
8. What climatic conditions does it best suit?

9. Describe the building of a grape trellis for the four-cane Kniffin system.
10. When would you tie up canes for each of these systems of trellising?

Activities.—Build trellises. Make trials to compare results of close pruning with those of slight pruning. Trellis vines to contrast two or more approved methods, and determine which is best for your conditions.

Fruiting Habits of Grapes.—Grapes are borne on shoots produced that spring. These spring shoots grow from buds

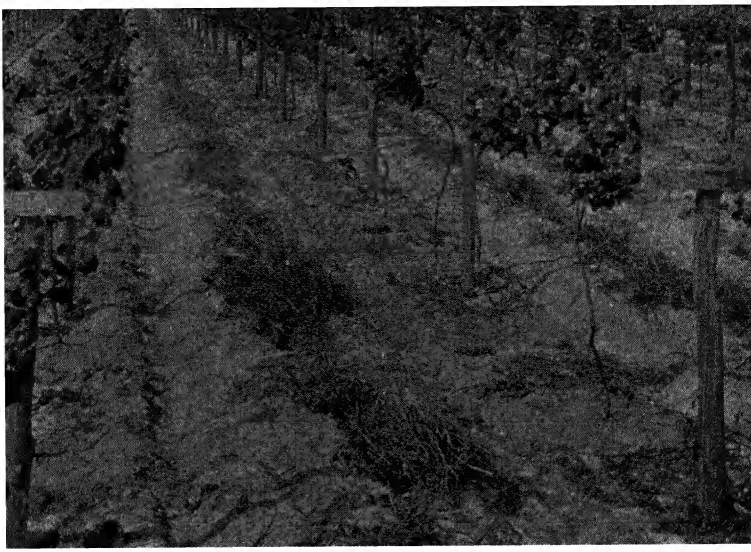


FIG. 189.—When the winter cover crop is plowed down, a ridge is thrown toward the center, and this is worked down later by disking. Trellising is by the Munson system. Note the two-foot cross arms with wires at their ends.

formed the preceding season. The young shoots have a few leaves and bear blossoms which form the fruit clusters. Each new shoot or cane bears several clusters of blossoms and grapes. If too many buds on last year's growth are kept, the vine is unable to supply all with enough water and plant food to produce a satisfactory crop. Better fruit and better results are obtained when the annual pruning is systematic and thorough.

On home trellises grapes are often neglected, as the owner wishes shade rather than fruit. This plan has its good points,

but the owners should not expect both shade and fruit in abundance.

Pruning.—Grapes should be pruned every winter when the vines are entirely dormant. Delay in pruning may result in weakening of the vines by loss of sap. Usually hand pruning shears are the only tools needed.

The system of pruning and the system of trellising should harmonize with each other. (Fig. 190.) Make the pruning rather

Fig. 190.—Training young grapes to posts. Pruning detail shown at left for single post system. (S. C. Exp. Sta.)

close each year. As the crop is borne on the new growth, there is very little need of saving much of the old wood. Retain old wood to form a trunk and enough of the last season's growth to furnish the buds necessary for the main shoots next year. If about ten buds are left on each of the four canes of the Kniffin system, there will be as much new wood produced the next season as the root system can support, and enough to bear a crop of fruit.

Four-Cane Kniffin System.—Trellising grapes by this system requires only two horizontal wires. These are usually num-

ber 10 or larger in size. The upper wire is four feet from the ground and the other about eighteen inches lower. When pruning the vine in the winter, a cane of the last season's growth is left on each side of an upright trunk for each wire. (Figs. 191 and 192.) Usually the lower horizontal canes are shorter than those on the top wire. Weak canes may be cut shorter than strong ones. The most vigorous canes should be used. Always cut canes about one-half inch beyond the bud. If the old trunk or upright needs renewing, it is often possible to choose a new one. This system is easily followed by experienced pruners.

FIG. 191.—The upright and four main arms of the four-cane Kniffin system are clearly shown in this unpruned Concord vine. (S. C. Exp. Sta.)

The one-year canes are tied to their wires and little summer tying is needed in this plan. Light and air are freely admitted and the height for picking is favorable.

Two-Cane Kniffin System.—This plan differs from the preceding in having only half as much wood. A single vine is used, and is placed at three or four feet from the ground. Two horizontal canes from the upright trunks, each about three feet long, are tied to the wire, permitting the new shoots and fruit to hang down. The effects of this system are better quality of fruit, but less of it.

Munson System.—Three wires form the trellis. Two are near the ends of the two-foot cross-arms, four and a half feet above the ground. The lower wire is stapled to posts about six inches

from the top. Pruning is done as in the case of the two-cane Kniffin system. The new growth each summer lies horizontally over the two side wires. No tying is necessary. The fruit can be sprayed thoroughly and is easily harvested. The hanging bunches are exposed to the air and are less affected by black rot. This form of trellis is more expensive than the Kniffin trellis.

Building Trellises.—Use durable posts, well anchored in the soil. Good braces should be used at the ends of the rows so that heavy wires may be stretched tight. Students should participate in building trellises.

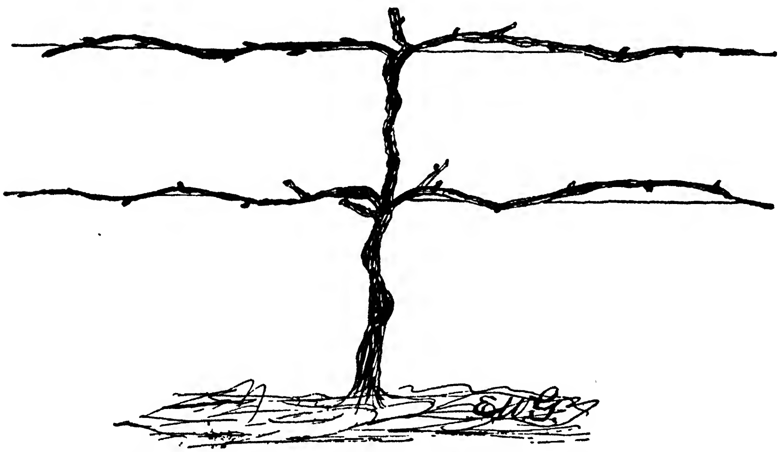


FIG. 192.—Grape vine pruned by the four-cane Kniffin system.

Job 9. Controlling Insects and Diseases

Conditions Usually Found.—(1) Vineyards are often attacked by several serious diseases and insects. These are readily controlled in commercial vineyards. (2) Home vineyards are often neglected, and black rot and other diseases destroy the crop.

Aims.—Growers should understand the symptoms of disease and insect enemies, and methods of preventing or controlling both.

Problems for Study and Discussion

1. Find from local growers what vineyards have been attacked by black rot; by other diseases.
2. Find what insects are serious in your region.
3. What diseases and insects are considered serious in other regions?
4. Describe the attacks of black rot of grapes and tell how to prevent this disease.
5. Describe the attacks of powdery mildew and of downy mildew and give directions for their control.

6. What is anthracnose? How is it controlled?
7. Describe the grape leaf-hopper and its work, and give remedy.
8. Give the life history of the leaf-folder.
9. What damage is done by the grapevine flea-beetle? How is it controlled?
10. Describe the effects of rose chafers and tell how to fight them.
11. What grapes are attacked by phylloxera? How can this be prevented?
12. How can you control grapevine root worms?

Activities.—Put spray equipment in order for use. When leaf-eating insects are to be controlled, try both dusting and spraying on different vines and compare results. Follow the spray schedule given in this job and study the effects.

Scale Insects.—There are several types of scale insects which are sometimes serious on grape vines. These vary slightly in shape and color. They are all more injurious on varieties of grapes which do not shed the outer bark, such as members of the Muscadine group. They are all readily controlled by winter spraying with lime-sulfur or with oil emulsion.

Aphids.—Plant lice sometimes attack the young and tender growing shoots. They are easily controlled by spraying with nicotine or with a summer strength of lime-sulfur.

Grape Leaf-hoppers.—These minute sucking insects are yellowish white in color. They hop and fly quickly when approached and are therefore difficult to control. They hide beneath the leaves, sucking sap and weakening the plant. Leaves turn light brown in color or lose the dark-green appearance. Many leaves may fall from the vines.

As the adults live over winter in rubbish and crevices about the vines, close pruning and clean-up methods are advisable. This insect, like all other sucking insects, should be sprayed with nicotine sulfate diluted with about one thousand parts of water. This may be mixed with other spray materials in fighting chewing insects and diseases. If two operators work at the same time, one on one side of the row and one on the other, the insects cannot protect themselves so readily by their quick movements.

Grape Leaf-folders.—This enemy occurs throughout the United States. Its damage is of less importance than that of some other grape insects. The larva folds the leaf over and fastens it with a web. It feeds upon the leaves and other green tissues.

If the attacks are not serious, the larvæ may be crushed by hand or the leaves picked off and burned. In bad attacks spray-

ing with poison, as arsenate of lead, is recommended. Do this while spraying with a fungicide against diseases.

Grapevine Flea-beetles.—The buds of the vines are attacked in early spring by flea-beetles. If poison is used with the fungicide when fighting black rot, this enemy may be readily controlled. It is somewhat more difficult to poison than most insects and the strength of the poison should be at least doubled when flea-beetles are present.

Grape Berry Moths.—Eggs laid on or near the blossoms hatch, and the larvæ attack the blossoms and buds and make webs among the blossoms. A second and a third brood come later in the season, overlapping somewhat. These attack the fruits, living on the pulp and seeds. They spoil many clusters and cause rot to attack the fruit.

The regular spraying schedule should control these insects if applied at the right time. It is found advisable to mix a sticker with the poison material. This may consist of resin fish-oil soap in the spray applied just before the grapes touch in the cluster. Successful poisoning of the early brood saves trouble later.

Climbing Cutworms.—There are several species of cutworm which climb trees, grapevines, and other plants to eat tender parts. Several of these attack young fruit buds of grapevines in spring, doing their feeding at night.

It is difficult to poison these cutworms. They are less serious when some cover crop is growing on the soil, as they seem to prefer such crops when green. They are much more serious in sections having light soils. Cotton-batting collars and bands of tanglefoot used on the trunks of vines will prevent the climbing.

Rose Chafers.—The blossoms of grapes are often seriously attacked by these beetles, which also eat the surfaces from the leaves. When the beetles are very abundant, the most successful and practical method of control is to use excess arsenate in the regular spray schedule, adding a gallon of cheap molasses to each 100 gallons of material to induce beetles to eat the poison more freely.

Grapevine Root Worms.—The adult beetles are small, grayish brown insects. When they appear in spring they begin feeding on the leaves, sometimes nearly defoliating the vines. In mild cases, only holes in the leaves are noticed. Eggs are soon laid under the loose bark of the vines. The young larvæ drop to

the ground when hatched and work into the roots. From this habit the name is derived. The root system is sometimes nearly destroyed, causing the dropping of fruit and leaves. A weakened appearance is certain to be noticed and the vineyard is greatly impaired.

Poisoning, as for other leaf-eating insects, is the best method of fighting these beetles. Use one to two pounds of arsenate of lead in fifty gallons of water or mix the poison with Bordeaux, lime-sulfur, or nicotine sprays when fighting other enemies. Clean cultivation early in the spring may destroy many of the wintering places of the larvæ.

Phylloxera.—This is chiefly a trouble in varieties with fleshy roots. The Vinifera grapes are especially susceptible to it except when they are grafted upon resistant stocks. Good species for use as such stocks are the River grape (*riparia*) and the Fox grape (*rupestris*).

Black Rot.—This disease is doubtless the worst enemy of the grape. There are very few grape-growing regions where it is not a serious trouble. The disease attacks the young shoots, tendrils, leaves, and fruit. It is most noticeable upon the fruit. Crops are greatly reduced by the disease. Clusters are thinned and the berries shrivel and drop. Mummied fruits hold many spores over winter and the spores lodge in crevices of the bark and buds. Warm, rainy weather multiplies the spores rapidly in spring and they attack new tissues not protected by spray material. Minute black spots are formed which spread rapidly and cover the whole surface of leaves, twigs, and fruit.

Spraying is very effectual against this disease if it is applied in time, before the spores find lodgment in new tissues. Use Bordeaux mixture as for other diseases.

Applications should be made (1) in the spring when the buds are swelling, and before they are pushed out an inch; (2) when the shoots are five to eight inches long; (3) just before the blossoms open; and (4) just after blossoming is over. A fifth and sixth application may be made to keep the new growth protected, at intervals of about two weeks. The last two sprayings are not commonly applied unless the disease has been very severe. The sprays 1 and 2 prevent the formation of carryover cankers to the following year. The sprays 3 and 4 are important in controlling the present year's disease.

Burning of prunings, plowing under any spores in materials upon the surface of the soil, clean cultivation, and cutting away of basal suckers or shoots are all good preventive measures.

Downy Mildew.—Green tissues of the plant are attacked by this disease. Leaves turn yellowish or brown. Vines are often nearly killed and yields are greatly reduced. A grayish coating often appears when the fruit is attacked. The disease is readily recognized by the downy appearances on the under surfaces of the leaves and on twigs and fruit.

Spraying to prevent black rot should also prevent downy mildew. The clean-up methods recommended for black rot apply equally well here.

Powdery Mildew.—The two mildew diseases of grapes are somewhat similar, but powdery mildew attacks both surfaces of the leaves and seems to work more on the surface. The disease is more generalized over the whole vine, leaves, and fruit. It gives an appearance of white powder dusted over the plant. At first the leaves present a mottled appearance, but later the whole leaf is affected and dwarfed. A moldy odor may be noticed in the advanced stages. If blossom clusters are attacked, fruit fails to form, or young berries may drop from the clusters. The crop may be destroyed.

Moist weather is favorable for the growth of this disease. Vines planted with plenty of room, well opened on trellises, or closely pruned are less likely to be affected, as more sun and ventilation are provided. The clean-up methods and the spraying campaign recommended for black rot should be followed for powdery mildew. Some growers dust the plants with sulfur if attacks are threatened at blossoming time. This should be used as a preventive rather than as a cure.

Anthracnose.—Because of the nature of the attack, this disease is called *bird's-eye rot.* It attacks young canes and is very conspicuous on leaves and fruit. Deep sunken areas or cankers and grayish or dark discolorations on the under surfaces of canes give a burned appearance. Brown spots with whitish centers are often seen on the fruit. Cracking of the berries may follow. Dried, mummified fruits sometimes appear as in the case of black rot. Clean-up and spraying campaigns recommended for other diseases are effectual against anthracnose.

Spraying Program for Grapes

Time of Application	*Materials to Use*	*What For*
1. During winter when vines are dormant.	Bordeaux 4-4-50 and oil emulsion in combination or Lime-sulfur 5° B.	Scale insects and fungous diseases.
2. Just before blossoms open.	3 lbs. arsenate of lead in 100 gals. Bordeaux 4-3-50.	Flea-beetles. Rose chafers. Anthracnose. Black rot. Mildew.
3. Just after blossoms fall.	Same as above.	Flea-beetles. Rose chafers. Grape leaf-folders. Anthracnose. Black rot. Mildew.
4. When berries begin to touch in the bunch.	Same as above plus ½ pint of nicotine sulfate, in 100 gals. 1 lb. calcium caseinate.	Leaf hoppers. Aphids. Leaf-folders. Fungous diseases.
5. Two weeks before fruit is due to ripen.	2 lbs. of neutral copper acetate; * 1 lb. calcium caseinate in 100 gals. water.	Black rot. Mildew.

Two other sprays given as 1 and 2 in the treatment for black rot may be included if rot has been serious.

* Important: Should be applied when the temperature is low to safeguard against burning.

Job 10. Harvesting, Grading, and Packing

Conditions Usually Found.—Much of the commercial product appears in the market in poor condition.

Aims.—The best and most economical methods of harvesting, grading, and packing should be understood by students.

Problems for Study and Discussion

1. How do growers judge the ripeness for market of early varieties?
2. What differences in picking time would you make for grapes intended for home use?
3. Give directions for carefully picking grapes without injury.
4. Debate picking on trays or in large baskets to be sorted and repacked vs. picking in market containers.
5. Why would you want a packing shed in a commercial vineyard? Where located?
6. What containers should be purchased for marketing the grape crop?
7. Why are grapes heaped in the basket and allowed to wilt before being covered?

Activities.—(1) Trials should be made to test the value of grading in the field compared with grading and packing at a packing shed. (2) Test the value of letting grapes settle for several hours before covering the baskets.

Stage of Ripeness.—Grapes color several days before they are really ripe. For shipment, picking may occur earlier than otherwise. For home use or for sale in local markets the fruit

FIG. 193.—Picking grapes requires much skill. Boxes or baskets are often packed in the vineyard to avoid extra handling.

should remain on the vines longer. Grapes do not ripen after they are cut from the vines and should reach their highest sugar content before harvesting. They will improve in flavor, aroma, and appearance.

Removing Bunches.—Grapes should be handled by the main stem of the bunch. They should be carefully removed from the canes with the use of picking scissors. The berries should be touched as little as possible by the hands. For the bunch grapes with slip skins, it is best to handle the bunches as little as possible.

Picking Containers.—Flat boxes, lugs, or field baskets are often used by pickers if trimming and shed packing are to be practiced. Many commercial growers consider it a good plan to pick the crop directly into market baskets, thus avoiding a second handling (Fig. 193). This plan requires that each picker shall know how to pack baskets properly. It is good if the bunches are perfect, or nearly so. If much trimming is necessary this plan is not suitable.

Trimming and Packing.—In small baskets the bunches are placed at an angle so that the weight of each bunch is against

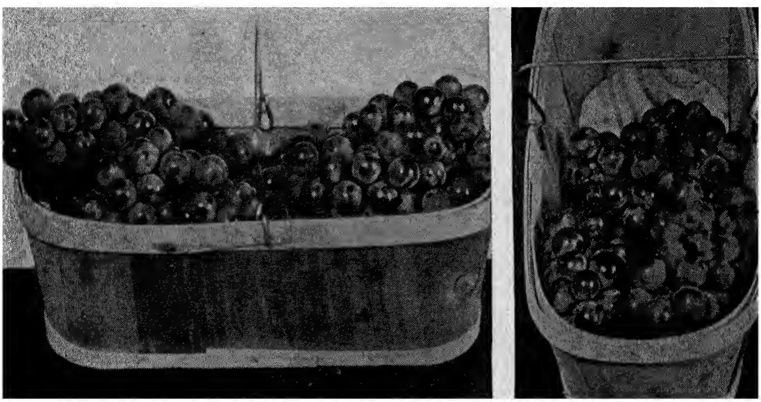


Fig. 194.—Climax baskets are much used in marketing grapes. Bunches are handled by the stems. Packing begins at one end of basket, as shown at right. Covers are placed after grapes have settled.

the next bunch or against the side of the basket (Fig. 194). Baskets should be made to heap a little at first. The covers for the baskets are not put in place until the next day. This allows the stems in each bunch of grapes to collapse or settle a little, and the berries lie closer together. If this precaution is not taken, the baskets will reach the market in a loose condition.

Containers.—Climax baskets with temporary or permanent handles over the center are commonly used for grapes. There are several sizes of these used, the three-pound, five-pound, eight-pound, and the twelve-pound. The small sizes are used in the early part of the season. Georgia peach carriers are also used for grapes. These contain six gallon baskets.

A Packing Shed.—This is a place where grapes may be repacked, or where the baskets may be assembled during the wilting stage. Containers may be stored temporarily in the shed. It should be located in a central position or near the road where the trucks or wagons must be loaded.

Job 11. Marketing Grapes

Conditions Usually Found.—Commercial grape growers usually market their crops successfully. Unsatisfactory results sometimes occur. Surplus grapes are more commonly used than formerly for grape juice.

Aims.—The best methods of marketing grapes should be understood. Suitable outlets for surplus fruit should be learned.

Problems for Study and Discussion

1. What has been the range of prices for grapes sold during the last few years?
2. How do these compare with prices paid by consumers for grapes?
3. Talk with managers or with grape growers who have been successful in marketing, to learn their methods.
4. What difficulties have they had which could be prevented?
5. How do they avoid shipping to congested markets?
6. How much have they spent in a season for telegrams and telephone calls in locating favorable markets?
7. Get opinions of growers regarding coöperative associations.
8. Ask particularly regarding the saving by buying supplies through such an association.
9. Review advantages of coöperative marketing in the stone-fruit and apple enterprises.
10. Locate the nearest grape-juice plant for your region.
11. What other use is made of surplus fruit besides making grape juice?

Activities.—(1) Compare two or more methods of setting grapes. (2) Try making unfermented grape juice for use in winter. (3) When grapes are low in price make up a lot into grape juice and sell the product. Compare the returns by the two methods.

Methods of Loading and Shipping.—The four-basket crates of the California type are loaded 900 to 1170 per car. The crates are stacked and held in place with strips, in such way as to afford maximum ventilation.

Shipments are made by express to neighboring markets and in refrigerator cars to distant markets.

The harvest season usually lasts from three to six weeks, during which time several pickings are usually made. A successful grower estimates that one hundred acres of three-year-old vines should give twenty to twenty-five cars per average year.

Coöperative Marketing.—Among the elements for successful marketing of grapes may be mentioned the following: (1) ar-

ranging for outlets and controlling sales in advance of harvesting; (2) being able to guarantee a uniformly packed product; (3) having a large enough supply to satisfy large buyers, either individually or through coöperation with others; (4) having cars engaged and ready for shipments; (5) knowing the market situation in the different market centers; (6) moving fruit promptly and rapidly in properly iced or refrigerated cars; (7) using express shipments when car lots cannot be produced; (8) shipping a steady supply to satisfy regular buyers; (9) diverting shipments when congestion is discovered ahead; (10) telegraphing and telephoning constantly to always avoid congested markets; (11) attending to business details punctually.

Avoiding Congestion.—Keeping a close account of the situation in each market is necessary for success. Much telegraphing and telephoning may be necessary. A good agent in each market center should be located and his confidence established. If possible, buying agents should be brought to your shipping point and to the local vineyards, so they will understand the situation. Ask them to warn you by telegram when markets are becoming crowded. They may know how many cars are enroute to their markets at any time, and can aid shippers in diverting cars and by predicting slumps in their markets. Confidential agents may be relatives, commission men known personally, jobbers, local dealers who keep close watch on markets, or local growers who understand market conditions well.

Job 12. Keeping Records

Suitable record forms for keeping records for the Grape Enterprise are shown in the Melon Enterprise. Send for the blanks and record books as there suggested. Fill one set of blanks, using data from a grape grower.

Grape Calculations.—1. A grower planted 435 grape vines per acre. At what distance were the vines, if set in squares?

2. The labor cost the first two years for establishing a vineyard was $109.75 per acre. The cost of the vines, wire, posts, nails, etc., was $198.25. Find the total cost. What percentage of the total cost was the labor?

3. A grape grower applied 500 lbs. of bone meal to his vineyard in late summer, 500 lbs. of a 5-8-5 fertilizer in early spring, and 500 lbs. of the same mixture in May. Secure the present prices on fertilizer materials and find the cost of the fertilizer applied in the year.

4. A grower finds that it costs him an average of $5 per acre for spraying his vineyard, but by giving an extra application he can increase his yield 150 pounds. If the fruit is worth 12 cents per pound, what percentage does he make on the money invested for spraying?

5. A young man grew an intercrop each of the first two years after setting the grapes. The first year he made from early Irish potatoes $105 above the cost of growing them. The next year he grew head lettuce, making a net profit of $215. Compare these results with vineyard costs in problem 2 and find the percentage of profit for the first two years.

6. A young man found he would need three terraces in a hill for planting a vineyard, which he could make at an extra expense of $5 each. He estimated this will save as much as half the fertilizer bill each year. If he applied $45 worth of fertilizer each year, find the profit from terracing the first year. Find the amount saved during the next three years.

7. A high school student made 1,200 grape cuttings while pruning his home vineyard and grew them for one year at a total cost of labor, land, fertilizer, etc., of $20. He was able to sell 850 good vines at $8 per hundred. Find the net returns from this nursery project.

Unfermented Grape Juice No. 1

Pick over and wash grapes
Sterilize jars as for canning
Put 1 cup grapes into quart jar
Put ¾ cup sugar into jar
Fill jar full of boiling water
Adjust rubber and seal
Invert jar often to dissolve sugar
Set away in cool place
Do not use under six weeks
Fine for invalids or flu patients
Splendid for cool, summer drinks

Unfermented Grape Juice No. 2

Pick over and wash grapes
Place in kettle and almost cover with water
Boil, stirring frequently, 20 to 30 minutes
Strain through cloth, over night
Add 1 cup sugar to 1 quart juice
Bring to galloping boil
Seal in sterilized fruit cans. Use as No. 1
Can be reduced with equal parts of water

Grape Jelly

Use pomace from Grape Juice No. 2
Cover it with water and stir well
Boil 15 or 20 minutes. Strain
Make jelly from juice
Use ¾ cup sugar to 1 cup juice

ENTERPRISES IN BEAUTIFICATION

Collaborator: John L. Butts, B.S., Formerly Teacher Dade County Agricultural School, Miami, Fla.

Analysis into Jobs.—Any enterprise in beautification of premises by ornamental planting may be analyzed into the following jobs. Reference should be made to U. S. Farmers' Bulletin 1087, and to books listed in the Appendix.

1. Determining the possibilities in this enterprise.
2. Planning the landscape planting.
3. Grading grounds for planting.
4. Constructing walks and drives.
5. Selecting the proper kinds of plants.
6. Setting plants.
7. Establishing lawns.
8. Caring for plants and lawns.
9. Fertilizing.

Job 1. Determining the Possibilities in This Enterprise

Conditions Usually Found.—Few home grounds and school grounds are beautified as they should be.

Aims.—The values and costs of suitable beautification of home grounds and of school grounds should be understood.

Problems for Study and Discussion

1. What percentage of the value of a house and lot should be spent on beautification? How much is usually spent?
2. For every dollar invested in the beautification of a house and lot, what returns in increased valuation may be expected?
3. Who can be responsible for the beautification of the school grounds?
4. How much will the beautification of your school grounds cost?
5. How much of the work could be done by the class in vocational agriculture?
6. How may costs of nursery stock be minimized?
7. Enumerate the benefits to be gained by beautification of home grounds. Of school, church, and court house grounds.

Activities.—Students should each visit and study a number of homes, schools (Fig. 195), public grounds, highways, railway lines, and station grounds, whether beautified or not, and report to the class on the possibilities shown.

Reasons for Beautifying Home Grounds.—In ancient times man made the discovery in esthetics that the beauty of a jewel

depends largely upon its setting. For centuries this principle has been recognized and applied in the creation of homes for the wealthy, but in the construction of homes for people of moderate means the matter of landscaping has been either entirely lacking, or handled in a most inadequate manner. The amount required for adequate landscaping seldom needs to reach 5 per cent of the total cost, while the enhancement in value, as proved in thousands of cases, doubles the value of the premises. When

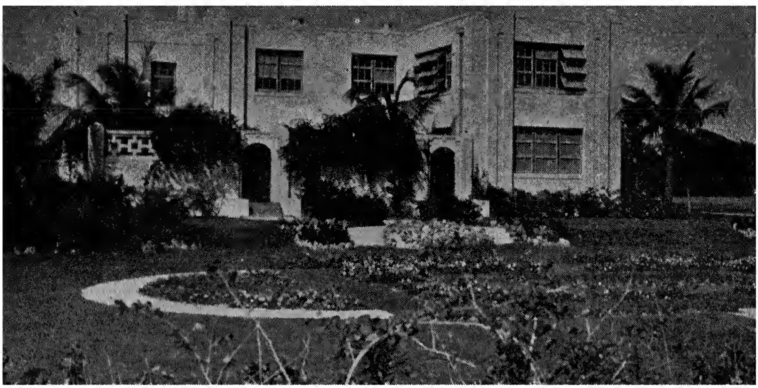


FIG. 195.—Compare the successful landscape planting here with poor examples you have seen.

such facts are considered, it is hard to understand such lack of interest.

School Premises.—Many people are inclined to believe that grade children and older students are careless and destructive and, for that reason, little landscaping of the school grounds should be done. When properly trained and directed in the planting work, students take pride in keeping the grounds and often show great creative capacity. It is a splendid project for the class in vocational agriculture to undertake the beautification of the school grounds. This class should take the lead in the work, but each student in school should accept his part. The beautification of the school grounds of all the schools of the county has been undertaken by departments of vocational agriculture in many cases. The work at Dade County Agricultural School, near Miami, Florida, is outstanding. (Fig. 195.) The

students of each department may grow plants, make landscape plans, plant school grounds, and maintain the grounds. The county school board of the local school districts may or may not pay the students for their work.

Benefits to Students.—When such kinds of work are done by agricultural students and others the benefits are chiefly along the following lines: (1) Natural art is learned. (2) Special uses of trees, vines, shrubs, and grass are understood. (3) Names of

Fig. 196.—A porch entrance, showing snowball, weigelia, privet shrub, arbor vitæ, and sword fern.

the different kinds become familiar. (4) Unsightly objects are hidden. (5) People begin to talk about the beauties of the place. (6) Visitors are attracted and soon begin imitating the planting at their homes. (7) Public pride and student pride in the school are aroused. (8) People are more willing to support the schools. (9) Filth and litter are cleaned up and no longer accumulate. (10) The grounds assume a park-like air with inviting shade.

A School Nursery.—It is also possible for the department of vocational agriculture to grow many, if not all, of the plants needed for landscaping the school grounds and other grounds. Community nurseries for the growing of ornamental plants may be run as community or as school projects. This plan saves much of the cost of plants.

Where Planting is Needed.—Beautification planting should be encouraged in a number of places besides the home grounds (Fig. 196) and school grounds, as around churches; along streets, highways, and railways; factory, warehouse, and mill sites; railway stations; parking places; garages (Fig. 197); filling stations; public squares; parks and streams; and, in fact, nearly everywhere.

Job 2. Planning the Landscape Planting

Conditions Usually Found.—Often little or no definite landscape plans are made but plants are put out here and there without any

FIG. 197.—A beautiful back yard, with vines on the fence, shrubs, privet hedge, peonies, and iris to lend their beauty.

thought of their relation to each other and the suitability to the surroundings.

Aims.—The students should learn good methods of working out landscape plans.

Problems for Study and Discussion

1. What are the values of having a definite landscape plan?
2. What are the two general kinds of plans used?
3. Describe each and give examples.
4. Debate the two kinds.
5. In making a landscape plan, what are the necessary steps?

Activities.—Make plans according to the steps given.

The Value of a Landscape Plan.—A plan or design for the landscape beautification should be made before any planting is done. The value of a good plan is as follows: (1) Due consideration should be given to the location of plants in regard to their size, color of bloom, habits of growth, or soil require-

ments. (2) Plants should be selected which will suit the size of the house and grounds. (3) If all plants cannot be purchased or grown at once they may be planted at intervals, and the order of planting should be considered. (4) The landscape effect should be developed to suit the surroundings, with due regard for individual tastes.

Steps in Making the Landscape Plan.—There are a number of steps in making a workable landscape plan: (1) On a temporary sketch get complete measurements of the area to be landscaped, with the size and location of the buildings, permanent walks or roads, and any growing plants. (2) Get the elevations and slopes of the land in order to determine what grading or fills will be necessary. (3) Draw to scale a map of the area, locating the buildings, walks, roads, trees, and the like. (4) Lay out on the map all additional necessary buildings, walks, and drives. (5) Design the planting schemes, indicating materials needed and the location for each plant on the plan.

There are two general types of landscape plans, which are briefly described.

Formal Planting.—The oldest designs in landscaping are called the formal plans. The grounds are laid out by instruments into circles, squares, diamonds, rectangles, and other geometric figures. The places often include formal statues or figures. Such a plan may be valuable in laying out city parks, statehouse grounds, or the grounds of a large estate.

The Natural Method of Planting.—By this plan plants are often massed, with due regard to their future growth, and set to appear as if they were natural in their location. Formal arrangements and geometrical figures are avoided. Trees are often grown in clumps. Formal pruning is not practiced. The natural plan is generally used for landscaping of schools and home grounds and is even more popular than formal planting.

Places for Shrubs.—Shrubs not too high should be grown in clumps along foundations of buildings, in what is called "base" or "foundation" planting (Fig. 198). This helps to blend the lines of the building into the greensward. Mass shrubs where roads and walks join; in the curves or angles of walks and drives; in the angles of hedges or fences; where roads intersect fences; along borders; and to hide objects. Try to suit the height of shrubs and colors of flowers to the place.

Job 3. Grading Grounds for Planting

Conditions Usually Found.—Few people properly fill and grade the home or school grounds to secure best effects. Some plant ornamentals without grading.

Aims.—The importance of grading and how grounds should be graded or filled should be known.

Problems for Study and Discussion

1. What instruments are needed in determining the grade or fill?
2. Who should use the instruments?
3. Describe the uses of stakes to show cuts and fills to be made.
4. How should the grading be done?
5. Give directions for securing good growth of plants afterward.
6. When should the fills be made?

FIG. 198.—A beautiful setting for a farm home. A walk of stones is up-to-date and inexpensive. Left, close view of Rambler roses on back-yard fence.

Grading Needs.—In many places we find the land far from being level or otherwise desirable. In order to make a good appearance when finished, we often find it necessary to grade certain places and to fill others.

Calculating the Cuts and Fills.—With a mason's level, a straight-edge, a few stakes, a tape, and a good eye any ingenious student can plot the grade and calculate the cubic yards of soil required to be moved or required for a fill. It should make a valuable geometry lesson. The same calculation can be based on data taken with a surveyor's telescope level if one is available. In figuring, do not forget that we want at least four inches of good, fertile top soil, and that all walks should be a little above grade of the adjoining ground.

Use of Stakes.—After the readings have been taken with a level, stakes should be driven at suitable intervals; and on these should be marked the amount of cut or fill to be made at each

place where a stake is located. Such stakes are of great help if much soil is to be moved.

Grading.—Where there is only a little grading or filling to be done, a wheelbarrow, a spade, and a shovel may be used; but for large fills or grades it is best to use a team, plow, and scrapers such as are used in building roads.

The grading and filling should be done several weeks ahead of planting time or before walks are constructed. The fills need time to settle before concrete walks and permanent roads are laid.

Job 4. Constructing Walks and Drives

Conditions Usually Found.—Often walks and drives are placed with no regard to the landscape, and frequently with little study of their uses.

Aims.—How to plan for walks and drives and how to construct them should be understood.

Problems for Study and Discussion

1. What factors determine where walks and drives should go?
2. Debate: Graceful curves vs. straight lines and angles for walks and drives.
3. Of what material should these walks and drives be constructed?
4. Give detailed directions for building the best walks and drives for your region.
5. Debate: Permanent materials vs. temporary materials for roads and walks.

Activities.—(1) Make plans showing the walks and drives of a place which is to be improved. (2) Assist in the making of walks and drives.

Locating Walks and Drives.—The plan for walks and drives should be drawn on the plans, and then staked right on the grounds. In placing walks and drives we must remember that there are good views to preserve, bad views to hide, dead wall space to cover, and that walks should lead from somewhere to somewhere in direct fashion. They should be useful. Avoid both extreme curves and sharp corners or angles. Suit the width to the purpose.

For schools the play-grounds should be located away from streets and traffic, leaving the front for beautification. If the grounds are small, it is necessary to confine the ornamental planting to the corners and to the sidelines, except for a solitary specimen or two. Eliminate all walks except the front one and others most necessary. If the grounds are large, there should be an extra walk leading to the play-ground; this may be very wide. In large grounds, batteries of swings or slides can be placed in

clumps of trees. Rockeries and pools may be built, or anything done that is suitable. Driveways should be wide enough in suitable places to allow for parking space for automobiles, or suitable parking ground may be graveled.

Concrete Walks and Drives.—These are usually made by a contractor who has the proper equipment, but high school students are capable of doing creditable concrete work. The concrete is artificial stone made from a mixture of sand and stone or gravel. The proportion of these different materials varies according to the kind of concrete needed. The usual mixture for concrete walks is 1-3-4 for the body, and 1 of cement to 2 or 3 of sharp sand for the top coat. The materials are mixed dry and are then wet to suit the work. Tramping and troweling the mixture in place brings the cement toward the surface and makes the walk hard.

Clay-sand or clay-gravel is used in many places and makes a satisfactory walk or drive if properly constructed. Wide walks or drives should be curved at least one inch in ten feet, raising them half an inch in the center for every two feet in width. By the use of a stout mall an even curve is easily attained. The edge of the walk should be an inch above the adjoining ground.

Macadamizing.—In places where it is available, crushed limestone is often used. It is laid and rolled in layers, the coarsest at the bottom and the fine on top until it is six or eight inches thick, according to the character of the soil. The surface may be oiled and sanded. The oiling should be done when it is perfectly dry.

Bitulithic.—Another common mixture consists of two parts of dry, screened lime rubble; one part of dry, screened coal ashes; and enough boiling coal tar or asphalt to make a paste that will spread like plaster. It is put on while very hot, in a three-inch or four-inch layer, and sanded immediately with fine sand to keep it from sticking.

Cheap walks may be of the stepping-stone type when suitable flag stones are found in the region.

Temporary walks and drives are often cheaply made of cinders, or of a thin layer of crushed rock or gravel spread on the soil. These should be considered temporary, as they need frequent surfacing and edging.

Job 5. Selecting the Proper Kinds of Plants

Conditions Usually Found.—Plants are often used without due regard to their value and adaptability.

Aims.—Students should know how to properly select plants for the beautification of grounds.

Problems for Study and Discussion

1. Make a list of the native trees of your community which may be used for beautifying grounds.
2. Prepare a list of introduced trees which may be used.
3. Make a list of the native and of the introduced shrubs which may be used.
4. Prepare a list of palms and palm-like plants which will grow in your locality.
5. What vines could you use in your beautification plan?
6. Make a list of the annual and the perennial flowering plants which you could use.
7. What kinds of grass would you recommend for the lawn?

Activities.—Collect nursery catalogs. Make lists for notebooks for evergreens, deciduous trees, ornamental shrubs, palms, vines, annual flowers, and herbaceous perennials. Make the lists in columns, giving one column for colors and one for uses.

Trees are used to frame a house or building and as solitary specimens. In addition to their value in framing the building they protect it from high winds and furnish desirable shade during the summer.

Trees, in general, are divided into two groups or classes: (1) deciduous, or those which shed their leaves in the fall, and (2) the evergreens, which maintain green foliage all the year.

Shrubs may be divided into evergreens and deciduous. The deciduous shrubs are grown for their flowers (Fig. 199), while the evergreens are valued for their leaves. Shrubs are used to blend the building with the landscape and are planted near all large buildings. They are also used in corners of grounds, angles of walks and drives (Fig. 200), in groups along driveways, or to hide certain views. In most cases they are planted in groups rather than as single specimens. Many of the shrubs may be used as hedges.

Palms are very good specimen plants in all sections of the South where they can stand the winter. They are commonly used along the Atlantic Coast as far north as South Carolina and along the Gulf Coast. There are many kinds described in catalogs.

Vines are used to add grace to buildings and to hide views

which are undesirable. They may be grown on buildings or on trellises. Vines do well on brick buildings but may slightly damage wooden structures. In making lists from catalogs record the method of support for each kind.

Pot or House Plants.—There is a great variety of plants from which to select for growing house plants. Some plants are grown on the outside and brought into the house during the blooming period. Plants are grown either for their flowers or for their showy leaves. Among some of the best flowering plants

FIG. 199

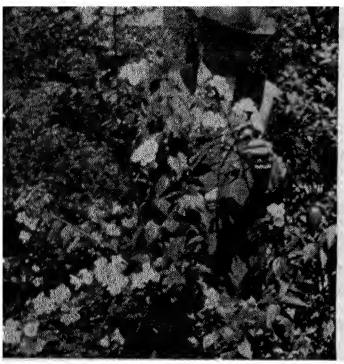


FIG. 200

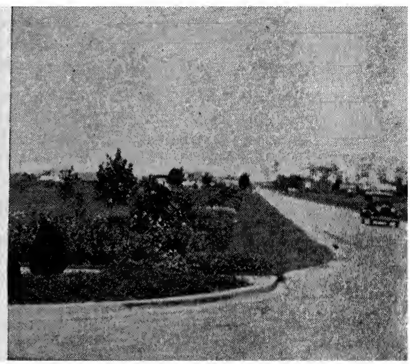


FIG. 199.—Syringa with full white blossoms, three years from rooted cutting. Syringas, deutzias, and weigelias are rapid growers and effective for planting. These and many ornamental shrubs grow from cuttings.

FIG. 200.—Appropriate planting in angles of roads is here shown. Approaching cars are not hidden.

for the house are begonia, cyclamen, freesia, fuchsia, geranium, gloxinia, heliotrope, impatiens, oxalis, primrose, rose, and many others. Such bulbous plants as hyacinth, narcissus, and tulip may be used during the winter.

Showy-leafed plants may be selected from the following list: asparagus fern, Boston fern, various small growing palms, caladium, cactus, coleus, cordyline, dracæna, rubber plant, pandanus, and wandering jew.

Annual Flowers.—No landscape is complete without the beauty afforded by a variety of annual flowers. Annuals are usually grown from seed and bloom at different periods from early spring to late fall. Some of the annuals, such as sweet

peas, nasturtiums, poppies, or lupines, are hardy enough to plant the seed directly to the place where they are to grow. The second class may be called half-hardy, because they may be grown by planting the seed in window boxes or cold frames and later transplanting the young plants to the open. The third class may be called very tender annuals and must be started in greenhouses or in hotbeds. Good lists of the annual flowers may be found in floral catalogs issued by seedsmen. In most cases, catalogs give descriptions of flowers and the purposes to which they are suited.

Grasses for Lawns.—There are a number of different kinds of grasses to use in making lawns. Certain of these grasses are adapted to only limited sections of the South. For the mountain sections and cooler parts of the South blue-grass is very good, but it will fail in other sections. The common grasses in use include the following: Bermuda grass, St. Augustine carpet, Charleston, Centipede, and blue-grass (Fig. 201).

Job 6. Setting Plants

Conditions Usually Found.—Many people fail to get ornamentals to live when they transplant them.

Aims.—Students should know how to transplant ornamentals successfully.

Problems for Study and Discussion

1. How are places for plants best designated?
2. How would you dig the holes for setting ornamentals?
3. Explain the different steps in setting the plants.
4. What care should such plants have after they are set?
5. How may water be provided for the plants?

Preparing Holes.—Having selected plant material, it is necessary to dig holes for the plants. A stake should be placed where each plant is to be set so that no mistake will be made in digging the holes. In most places the holes may be dug with a good spade or pick and shovel. Where the soil is extremely hard or where rock is near the surface it is sometimes necessary to use dynamite. The holes should be dug large and deep enough so that the roots will spread naturally and not be crowded. If soils are poor, some well-rotted manure may be placed by each hole to mix with the soil when planting.

Setting the Plants.—It is a good plan for one boy to hold the plant in the proper position, while another shovels in the soil.

The fine top soil is placed next to the roots. When the roots are covered with soil, turn on the water through a hose if possible, and, holding the plant with one hand so it will not settle too low, use the water to settle the soil by washing it between the roots and filling every cavity. Put on more soil, and more water; but do not fill the hole quite to the top. After the soil has settled for a day or two, the balance of the soil should be filled in, leaving a shallow rim to hold water.

FIG. 201.—Good use of shrubbery in foundation planting. The lawn is not dotted with shrubs but is kept well mowed.

Job 7. Establishing Lawns

Conditions Usually Found.—Many people fail in getting lawns started because of not properly planting them.

Aims.—How to establish a lawn successfully should be understood.

Problems for Study and Discussion

1. What kinds of seed would you use for a lawn?
2. How would you prepare the soil before seeding?
3. How much seed should be used?
4. If grass cuttings or roots are used, what quantity will be needed?
5. Describe the best methods of sowing and covering lawn seed.
6. How are grass cuttings and roots planted?
7. At what time of the year is it best to start a lawn?
8. Give suitable treatments for steep slopes.

Activities.—Make plantings with different grasses and compare the results.

Preparing the Lawn for Planting.—The first thing which has to be done before grassing a lawn is to grade it properly. All places graded down below the top soil should be covered again with rich garden soil. The land must be turned with a plow or a spade and the surface raked or harrowed several times.

The soil should be made extremely fertile before the grass is planted. If time will allow, a crop of cowpeas or soybeans should be planted and turned under. Another way to make the soil fertile is by the use of compost and commercial fertilizers. Use about 1,000 pounds of compost and 25 pounds of 4-8-4 commercial fertilizer for every 100 square yards. If the soil is acid, lime should be added at the rate of 50 pounds for every 100 square yards. The compost and the commercial fertilizer should be put on broadcast and worked in the soil when it is plowed.

Starting Lawns.—Lawns are usually planted either in the spring or in the fall. Special care must be taken in selecting grass adapted to the locality. For the lower South, the centipede grass is one of the best. It is a little slow in getting started but is easily kept because little mowing is needed. This grass spreads rapidly. The St. Augustine and the Bermuda are also used. The Bermuda, St. Augustine, and the centipede grasses are planted in the spring or fall by taking some sod and breaking it in pieces and planting them several inches apart. They are easily pressed into soft ground with a planting stick and are then rolled.

Kentucky blue-grass (Fig. 201), Italian rye grass, meadow fescue, and white clover may be used in the upper South. All of these mixed together give good results. Rye grass comes quickly and the lawn will present a good appearance while the blue-grass is becoming established. These grasses and clover are planted from seed. The amount of seed needed depends upon the size of the seed and the condition of the soil, ranging from one to three pounds for a hundred square yards of area.

Seeds should be sown with great care in order to get an even stand. It is usually best to sow the seed from at least two directions in order to get the seed properly distributed. Unless rains follow sowing to help cover the seed, raking or rolling is advised.

Banks and Steep Slopes may be kept from washing by using sod held in place by pegs. Bermuda grass or vines or shrubs may be grown if the soil washes badly. (Fig. 202.)

Job 8. Caring for Plants and Lawns

Conditions Usually Found.—Many people fail to give the plants and the lawn the proper care.

Aims.—Students should understand how to care for the lawn and the ornamentals.

Problems for Study and Discussion

1. How would you prune the shrubs?
2. What digging around trees and shrubs is advisable?

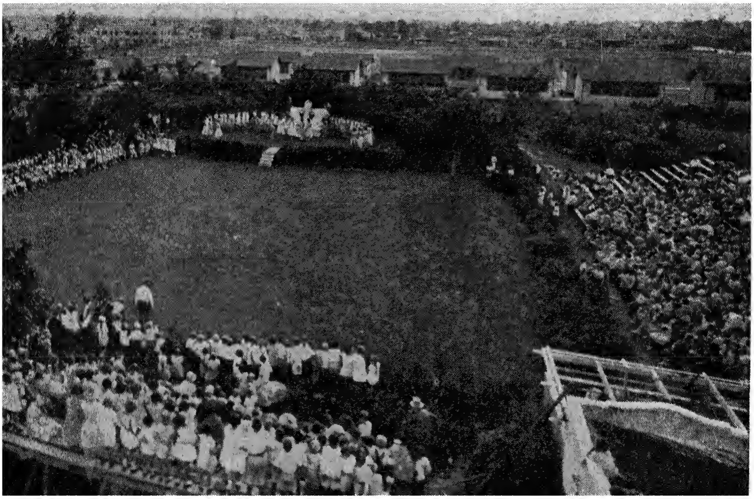


FIG. 202.—Outdoor stage with suitable planting, being used for May Day exercises. The beautiful scene was formerly a community dump heap. Slopes and banks were used to advantage.

3. How should the lawn be watered?
4. Under what conditions is reseeding advisable?
5. How would you mow the lawn?
6. Discuss needs for transplanting or moving shrubs.
7. Discuss the weed problem.

Activities.—Compare results from frequent mowing and from seldom mowing of lawns.

Pruning Shrubs.—Shrubs should be pruned to keep them at the proper height and in the proper shape. It may keep them from encroaching on walks and roads. The pruning is usually done during the winter months. Hand shears are used for this pruning. In most cases it is best to cut out the oldest canes at

the crowns. Long shoots may be cut back to cause them to branch and form more blooms.

Transplanting.—Trees and shrubs which are becoming too crowded or which are interfering with walks and drives should be thinned or moved entirely by transplanting to other places. Crowded shrubs may thrive better after transplanting. If soils are heavy it pays to dig around the ornamentals once or twice a year.

Reseeding Lawns.—Thin places in the lawn growth should be reseeded each year. Bare spots may be loosened by using a heavy rake when the soil is moist. Use plenty of mixed seed so that some kind will find the soil suitable.

Weeds in lawns may be dug out with chisels or heavy knives. This should be done before seeds are formed. Never allow weeds to grow among shrubs.

Watering.—After shrubs are set they should be watered about once each week during the first summer, unless plenty of rains occur. The lawn should be kept well supplied with moisture. This may be done by putting in a sprinkler system or by using a hose. It is better to flood the soil than merely to sprinkle the surface. Watering is best done at night.

Mowing the Lawn.—In order to keep the lawn in a good growing condition it is necessary to keep the grass cut. This can be done with either a hand or a power mower. It is a good practice to mow the lawn at least every ten days during the growing season. Never allow blossoms and seed to form. (Fig. 203.)

Job 9. Fertilizing

Conditions Usually Found.—Few people give the lawn and the ornamentals the proper fertilization.

Aims.—Students should understand proper fertilizing and manuring for ornamentals and lawns.

Problems for Study and Discussion

1. What method of fertilization of lawns and of ornamentals is practiced in your community?
2. How could you make a compost for use in manuring ornamentals and for topdressing lawns?
3. How should the compost be applied?
4. What care is necessary in the use of commercial fertilizers?
5. Under what conditions is liming advisable?

Fertilizing Ornamentals.—It is a good practice to mix compost or barnyard manure with the soil which is to be put around the roots of plants when being set. Compost may also be put around trees or shrubs in the early spring and worked into the soil. Well-rotted manure is best for these uses.

Commercial fertilizers may be used for fertilizing ornamentals but care must be taken in their use. A fertilizer analyzing about 4-8-4 is recommended. This may be applied at the rate of one

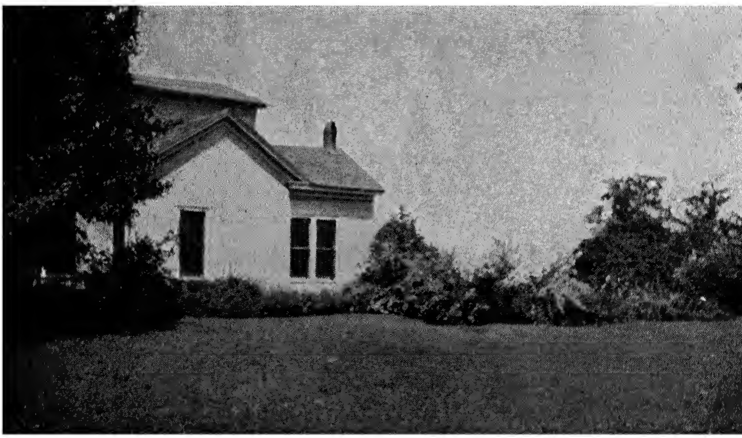


FIG. 203.—Foundation and mass planting of beautiful shrubs with suitable greensward in the foreground. (Univ. of Tenn.)

pound per shrub spread among clumps and raked into the soil. For large trees, as much as five or ten pounds may be spread in a circle around each tree, keeping some distance away from the trunk.

Fertilizing the Lawn.—Probably the best fertilizer for lawns is a good application of compost or well-rotted barnyard manure. Apply it each spring at the rate of 1,000 pounds for every 100 square yards. Commercial fertilizers may also be applied at a rate of 25 pounds of a 4-8-4 fertilizer for every 100 square yards. Nitrate of soda or sulfate of ammonia may be used during the summer. Apply it when the lawn is perfectly dry and then water heavily. It is better to give several small applications than a large one.

Calculations.—1. A young man selected 10 each of 10 kinds of shrubs and vines and planted the home grounds. A committee of judges in a contest said the place had been improved thereby $500. The plants cost $26 and the labor was $34. What was the percentage of gain over investment?

2. If the cost of a residence and lot is $7,500, what will be spent for grading and beautification if a person should spend 5% of the value for these purposes?

3. At $35 per ton, what will it cost to fertilize a lawn 4 rods square if 25 pounds are applied for 100 square yards?

4. Secure the local prices of copper sulfate and fresh lime. What will it cost to make 100 gallons of Bordeaux mixture (4-4-50) if the labor cost is $1?

Making a Compost

1. Spread 6 inches of manure
2. Add 4 inches of sod or leaves
3. Repeat layers 1 and 2 often
4. Make top flat to hold rains
5. Water if it becomes dry
6. Allow to rot for several months
7. Fork down one end to mix

Benefits of Composting

Rots coarse parts
Reduces bulk one-half
Unlocks plant food
Saves plant food
Destroys insects and fungi
Kills weed seeds
Reduces burning effects
Avoids injury to plants

Uses of Compost

Mix in flower beds
Enrich hotbed soils
Use in boxes and pots
Place in holes for trees and shrubs
Topdress lawn grass often
Use in greenhouses

ENTERPRISES WITH BULBS AND OTHER ORNAMENTALS

Collaborators: J. A. McClintock, M.S., Department of Horticulture, Purdue University, and John L. Butts, B.S., Formerly Teacher Dade County Agricultural School, Miami, Fla.

Analysis into Jobs.—Any enterprise in the growing and using of ornamental plants may be divided into the following eleven jobs. References are to U. S. Farmers' Bulletins, 157, 181, 218, 1087, 1495, 1567, 1591. See also U. S. D. A. Bulletins 1270 and 1462.

1. Determining the possibilities with ornamental plants.
2. Choosing types and varieties.
3. Selecting the location and the soil.
4. Providing a plant house; protecting plants.
5. Preparing the soil.
6. Propagating plants.
7. Providing plant food; applying fertilizers.
8. Cultivating and caring for plants.
9. Controlling insects and diseases.
10. Preparing products; marketing.
11. Keeping records.

Job 1. Determining the Possibilities with Ornamental Plants

Conditions Usually Found.—Many people fail in plant propagation work because they undertake it without any previous training and experience.

Aims.—Growers should decide whether or not it is profitable to grow ornamental plants. The enterprise should be one which involves a vocation for life.

Problems for Study and Discussion

1. What special equipment is needed for nursery work?
2. How long will it take for a person to be successful in building up his trade?
3. What is the usual cost of growing bulbs and ornamental plants?
4. What prices are usually received for plants?
5. What special labor requirements are necessary?
6. Describe a good location for a nursery.
7. Give regions for bulb nurseries.
8. Discuss yields and returns for bulbs.

The Advisability of the Enterprise.—The remarks to be made are based on the possibility of one person starting in the business of growing ornamental plants and giving some thought as to his plans in the beginning. One may base larger plantings on this information by providing for more special equipment. It is necessary that some suitable means for propagation of plants be provided, the details of which will be outlined in the following pages. The area needed depends very much upon the ideas of the grower. If he is a capable salesman as well as an efficient grower, his area may be enlarged according to the demand for his product and his ability to grow with the business.

Special Equipment.—Besides some type of propagating house, the grower will need a number of tools, such as a spraying machine, wheelbarrow, hoe, rake, shovel, pick, mattock, pruning shears, watering cans, trowel, dibble, tamper, spotting board, pots of various sizes, flats, pruning knives, budding knives, grafting tools, line hose, and small cultivator. The number of each depends upon the size of the business.

Where Bulbs are Grown.—Bulbs of the Narcissus group are commercially grown in North Carolina, South Carolina, Georgia, and Florida. Other states having similar soil and climate offer equal promise. Amaryllis and Easter Lily are grown to a less degree.

For best results, the temperature from September to June should not be lower than 28 degrees.

Cost and Profits.—Narcissus bulbs cost per acre from $1,200 to $2,000 for planting stock, fertilizers, cultivation, harvesting, and storing. The cost of producing blooming bulbs should not exceed $8 or $10 per thousand. The costs of most ornamentals rest entirely on local conditions. For instance, if there is a demand for 1,000 plants and the grower produces several times that quantity and has the balance left on his hands, he may find that the profits have been extremely low because of the stock not sold. It is not always possible to find a market for plants before they are propagated, but one should at least estimate carefully the demands of the market. See trade papers for available supplies.

It is very desirable to keep many kinds of ornamental plants in the nursery for more than one year and sell the plants when they are large enough for immediate effect. Of course,

these plants bring better prices than small plants but the cost of production and maintenance is likewise increased. (Figs. 204 and 205.)

Yields and Returns.—When 100,000 bulbs are planted which are two-thirds small planting stock and one-third "mother" and "double-nose" bulbs, the increase in round bulbs of marketable size should be thirty to forty thousand, bringing $300 to $500, and leaving forty to sixty thousand planting stock. Other ornaments offer good returns for a person who knows the business, has enough capital to run it, studies the market demands, and is willing to undertake the work as a life vocation.

Job 2. Choosing Types and Varieties

Conditions Usually Found.—Most growers specialize on growing a few kinds of plants, especially at first.

Aims.—Students should decide on which plants are best for them to grow and approximate quantity of each kind.

Problems for Study and Discussion

1. Of what importance is the locality on the type of plants to grow?
2. What ornamental plants are now grown in your community? What others would you add?
3. How will the area of land available help to determine the kind of plants to grow?
4. What are the best kinds of ornamental plants demanded by the market?
5. How long will it take to secure returns on the different kinds of ornamental plants?
6. Why would you try to avoid growing ornamentals which are attacked by scale or other serious enemies?

Kinds of Plants to Grow.—A definite decision should be made at the start regarding the type of material to be grown, because of the different requirements necessary. In most cases, it is advisable to select a few plants and specialize in them, branching out into other lines as experience and capital are obtained.

One should give thought to the location in selecting the kind of plants to grow. Certain locations seem to be more naturally adapted to the growing of a particular plant than others. Many plants may be grown out of doors in the lower South which would require a greenhouse farther north.

In selecting the kind of plants to grow, a person has his choice from a variety of different ornamentals. He may select plants

FIG. 204.—A student project. Plants suitable for bedding, foundation planting and other uses, being one and a half years in average age, and selling at 75 cents each. Propagation has been in home-made cypress boxes 6 x 6 x 12 inches. Plants may be transplanted to tubs for larger growth, as shown in Fig. 205. (J. L. Butts.)

FIG. 205.—Large plants, grown in "tubs" to the age of one and a half to three years, give immediate effect when planted out, and bring $5 to $6 to the grower. Note staking methods. (J. L. Butts.)

from the following groups: (1) trees, such as cedars, holly, oaks, dogwood, maples, and many others; (2) shrubs, such as honeysuckle, spirea, weigelia, bridal wreath, crêpe myrtle, and others; (3) vines, such as the Virginia creeper, English ivy, wisteria, and others; and (4) flowering plants, grown for cut flowers, as carnations, or others to be sold in bloom in the pots, as geranium, cineraria, and primrose.

Visit local nurserymen and make a careful study before you decide the kind of ornamentals to grow. Study nursery catalogs and lists in trade journals.

FIG. 206.—Bulb farm, Suffolk, Va. Tulips in bloom. (Atlantic Coast Line Ry.)

Bulbs of the narcissus group are popular. The best varieties are Paperwhite or Grandiflora; Chinese Sacred Lily or Oriental Narcissus; Soleil d'Or or Yellow Paperwhite; and Pearl White. See catalogs for varieties of other bulbs. (Figs. 206 and 207.)

Job 3. Selecting the Location and the Soil

Conditions Usually Found.—Care must be taken in selecting the proper location and soil for the different kinds of plants.

Aims.—Growers should know the proper location and soil for ornamental plants.

Problems for Study and Discussion

1. What locations are best for the ornamental plants which you have selected?
2. Which is better for a nursery, rich or poor soil? Discuss its depth.
3. Compare heavy and light soils for nurseries.
4. Of what importance is organic matter in nursery soils?

5. Discuss drainage for a nursery site.
6. What kind of soil is needed for pot plants? How may this soil be prepared?
7. Of what importance are transportation facilities in the locality of a nursery?

Locating the Nursery.—It is advisable to locate with due regard to the transportation facilities available. It is expensive to haul plants to the shipping station, and too great a distance may reduce the profits.

Due regard must be taken of the type of soil and of the slope. All other things being equal, a southern exposure is usually best.

FIG. 207.—Paperwhite narcissus multiplying field in full bloom. Left insert after flowers have been cut and shipped. Right insert, tops dying down. Castle Haysee, N. C.

Soils.—If ornamental plants are to be grown in the open field, a type of soil should be selected which will allow transplanting by use of a compact ball of earth for those requiring this treatment. If low, wet soil is selected, proper drainage must be considered; and high, dry land will need irrigation. It is also important to know if the proposed site has been infected with any serious fungous diseases or insect pests. Test soils or examine plants grown there. Lettuce is likely to show the presence of nematodes in a few weeks from sowing.

Bulbs require well-drained, rich loam soils with clay subsoils such as are best for Irish potatoes. Plenty of organic matter is essential. Soil is prepared as for truck crops.

Soil for growing pot plants or cut flowers can be made no mat-

ter where the location may be. A good soil for this purpose is as follows: equal parts of cow manure, leaf mold, loam soil, and sand, well-mixed.

Job 4. Providing a Plant House; Protecting Plants

Conditions Usually Found.—Growers of ornamental plants usually find it necessary to protect certain kinds of ornamental plants from the cold and from the sun by constructing a propagating house.

Aims.—Growers should know the type of propagating house to construct.

Problems for Study and Discussion

1. What is the lowest temperature in winter in your community?
2. List the plants which you want to grow which will not stand this low temperature.
3. Describe the construction of a slathouse; of a greenhouse.
4. What is the difference in cost between the two kinds of houses?
5. How would you determine the size of house to construct?
6. Work out a diagram of the floor plan for a slathouse and for a greenhouse.
7. How should the greenhouse be heated?

Kind of House to Construct.—Several factors are to be considered in deciding the kind of house to construct: The kind of ornamentals to be grown; the temperature of the weather in winter; the capital available; and the management to be followed. For example, a grower may depend upon growing all of his planting material in containers of cement, earthenware, or woodenware under lath or glass protection; or he may propagate these same plants and grow them in the open field. In the latter case much less space will be needed in the house.

The two common types of houses used are the slathouse and the greenhouse. The greenhouse is usually constructed with a brick or cement foundation and the sides and top are covered with glass. Steam heat is provided during the winter, making such a house expensive to construct and to operate.

The slathouse is constructed much like those used for *Asparagus plumosus.* (Fig. 208.)

Protecting from Wind, Sun, and Cold.—Young ornamental plants often require special protection from winds by growing them for a season or more in protected places. Plants which have been grown indoors in pots or boxes should never be exposed to sudden extremes of heat or cold. The hardening-off

principles followed with hotbed vegetables should be carefully observed in managing ornamentals.

Job 5. Preparing the Soil

Conditions Usually Found.—Soils are usually given very careful preparation.

Aims.—Students should know how to prepare soils for planting, by economical and thorough methods.

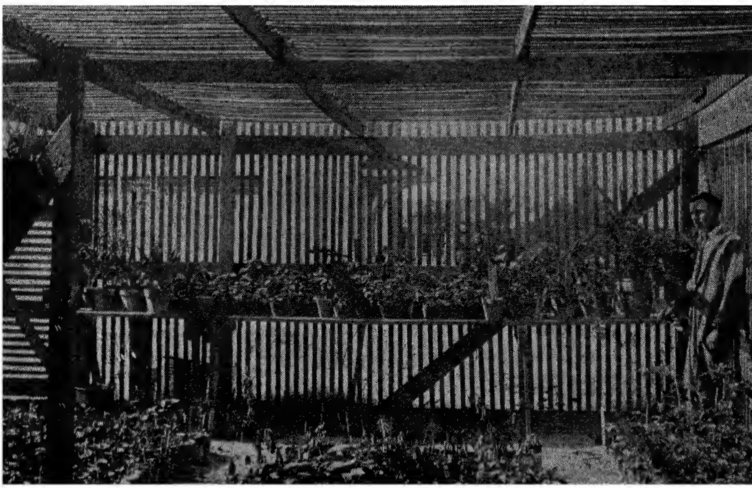


FIG. 208.—Interior of slathouse used for propagating a number of kinds of potted plants. Student project, one year after starting.

Problems for Study and Discussion

1. How should the soil in the open field be prepared for the plants?
2. What tools are necessary for this preparation?
3. How is soil secured for use in rooting cuttings?
4. What kind of soil would you use in flats for planting seeds?
5. How should this soil be prepared?
6. What is the value of sterilizing soils?
7. Describe the sifting and mixing of soils for pots and flats.

Preparing Soils in the Field.—Where plants are to be grown in the open field the soil is prepared in about the same manner as for a field crop. The soil is plowed six to eight inches deep with a tractor or team and turning plow, and then harrowed several times.

Preparing Soils for Cuttings.—Many growers use clean sand for rooting cuttings; however, good results may be obtained by using muck or loam soils. If the grower experiences soil trouble, like damping-off of plants or decaying of cuttings, the soil being used should be sterilized. Probably the best method of doing this is with steam. The cost of this must be taken into consideration.

Soils for Planting Seeds.—Soils should be free from parasitic diseases and should not pack easily. A good soil mixture for this purpose is one containing about one-third cow manure and two-thirds sandy loam. After this soil has been thoroughly mixed, add about one-twentieth of its volume of raw bone meal. The soil should be prepared several months ahead of the time it is to be used.

Job 6. Propagating Plants

Conditions Usually Found.—Ornamental plants are propagated by cuttings, by budding, by grafting, by layerage, and by separation or division.

Aims.—Students should understand how to propagate plants by each of these methods.

Problems for Study and Discussion

1. What equipment is needed for propagating plants?
2. How is grafting wax made?
3. What ornamental plants would you graft?
4. What plants are ordinarily budded?
5. What plants are propagated by separation or division?
6. What are the two kinds of cuttings which may be made?
7. Explain how to make a cutting.
8. How would you care for a cutting until it is properly rooted?
9. How important is layerage as a method of propagating ornamental plants?
10. Describe the planting of bulbs to be grown for market.

Activities.—Practice propagating by each of the methods mentioned.

Planting Seeds.—Depending upon the season of the year and the kind of plants, seeds may be planted in flats in the house or sown in the open field. All tender plants which may be injured from the cold or from the sun are usually planted in flats, hotbeds, or coldframes.

The seed, in either case, may be sown in rows or broadcast. If the young plants are to be cultivated, it is probably best to sow the seed in rows.

Seeds are covered according to the size, large seeds being cov-

ered deeper than others. Very small seed, petunia for example, are seldom covered at all but simply pressed down into the soil with a roller.

Other Methods of Plant Propagation.—In addition to the use of seed for plant propagation, plants may be propagated by the following methods: separation or division, layerage, cuttings, budding, and grafting. Certain types of ornamental plants lend themselves better to one method and other plants to another

FIG. 209.—Paperwhite or Narcissus grandiflora. Left, mother bulb with "slabs" or planting stock on sides. Right, blooming bulb of marketable size. Mother bulbs and "slabs" are slightly too round on inside. "Slabs" develop round bulbs the following year, and the mother bulb will produce more "slabs." A round bulb, shown on the right, will bloom and divide into "slabs" and mother bulb. The shoulder is more abrupt than in the Chinese Sacred Lily. The bulb is more firm, slightly smaller, and of darker color.

method; however, cuttings are probably used more than all of the other methods combined.

Propagating by Separation or Division.—Some plants naturally separate and form detachable organs such as bulbs, corms, tubers, etc. Bulbs often break up or divide into many small bulbs which may be used for new plants. The propagation of narcissus is by the formation of side bulbs (Figs. 209 and 210). Ornamental plants which are propagated by separation or division include many different kinds. Examples of these are: narcissus, lily, hyacinth, gladiolus, canna, orchid, dahlia, many ferns, and various other ornamentals. (Fig. 211.)

Propagating by Layerage.—Some plants habitually send out shoots or runners. The shoots or runners develop roots wher-

ever they are covered with soil. New plants are formed when connecting stems are detached. Many vine plants are propagated by this method.

FIG. 210.—Chinese Sacred Lily or Oriental Narcissus. Left, mother bulb with "slabs" or planting stock on sides. Right, typical round blooming bulb of marketable size. "Slabs" develop round bulbs the following year. Mother bulbs produce more "slabs." Round bulb, as shown on the right, will bloom and divide into "slabs" and mother bulb. The shoulder is less abrupt than in the Paperwhite; the bulb is less firm, larger, and lighter in color.

Propagating by Budding.—This plan involves the application of a single bud into the stock of another plant. The bud is inserted in contact with the cambium layer of the plant. Several methods of budding are practiced: shield budding, ring budding, plate budding, and others. The shield method is the one most commonly used.

FIG. 211

FIG. 212

FIG. 211.—Pampas grass is increased by dividing the clumps while in the most dormant condition. Taken in July of the second season after dividing.

FIG. 212.—Vocational students cultivating Paperwhite narcissus as a project at Sanford.

Budding has to be done when the bark will slip. It may be done during the spring and summer or in the early fall. If done in the fall, the buds lie dormant until the following spring. (See U. S. Farmers' Bulletin 157.)

Several types of ornamental plants are propagated by budding, as roses, dogwoods, and lilacs. Many of the fruit trees, including peaches, citrus, and others, are propagated almost entirely by budding.

Propagating by Grafting.—This method of propagation is often used for fruit trees, such as apples, pears, quince, and others. It is very often used for such ornamental plants as roses, lilacs, flowering crabs, dogwoods, etc.

The common methods of grafting are the whip-grafting and the cleft-grafting. (See the bulletin previously mentioned.)

Propagating by Cuttings.—The common method of propagating ornamental plants is by soft- and hard-wood cuttings. Cuttings may also be divided into four classes, depending upon the part of the plant from which the cutting was made: (1) stem cuttings, (2) leaf cuttings, (3) root cuttings, and (4) tuber cuttings.

Hard-wood or ripe-wood cuttings are made in winter, about eight inches long, and are set in rows in good garden soils, leaving only the top buds above ground. They are grown one year in nursery rows and then transplanted to places desired.

Many ornamental plants are propagated by hard-wood cuttings. Some of the common ones which are easily rooted are coleus, geranium, cactus, rose, hydrangea, oleander, rubber plant, sweet shrub, barberry, and bougainvillea.

Some of the thick-leaf plants, such as begonia, gloxinia, and bryophyllum, are easily propagated by leaf cuttings. The leaf is laid upon moist sand and held down by means of pegs, or the leaf may be cut in strips and partly covered with sand.

A few of the ornaments are propagated by root cuttings. Examples are dracæna and bouvardia.

Soils for Cuttings.—For rooting cuttings the soil should be well drained. Most growers prefer a coarse, clean sand for indoor cuttings, but hard-wood cuttings may be successfully rooted in a loam soil. In certain cases sphagnum moss, granulated peat moss, or cocoanut fiber may be used in the place of sand for soft-wood cuttings.

Care of Cuttings.—If soft-wood cuttings are made, they are usually rooted under glass and, in many places, with bottom heat. In other places the same cuttings are rooted in a slathouse which protects the plants from the sun.

All cuttings should be sprinkled frequently, but care must be taken not to keep the soil too wet, because of danger of rot. The length of time required for a cutting to take root depends upon the kind of plant. As a general rule, it usually takes from ten to thirty days to root cuttings. Most evergreens, as arbor vitæ, require a much longer time.

Planting Bulbs.—Because of mild climate of the southern states, bulbs are planted in September and October. Bulbs of the narcissus group should be out by the middle of October (Figs. 206 and 207). Usually, bulbs of this group are spaced twelve, fifteen, or eighteen per yard, with rows two to two and a half feet apart. The covering depth is usually four inches of settled soil above the "shoulders." Some growers prefer planting narcissus in double rows, the close rows being spaced eight or ten inches apart. The double-row plan offers advantages in holding up the flowers and shading the ground.

Job 7. Providing Plant Food; Applying Fertilizers

Conditions Usually Found.—Growers of ornamental plants usually find it profitable to use fertilizers.

Aims.—Students should know the kind of fertilizers to use, and in what cases they will be profitable.

Problems for Study and Discussion

1. What kinds of fertilizers do the growers of your community use?
2. How can you make compost for use in fertilizing ornamentals?
3. What are the dangers in using commercial fertilizers?
4. How may commercial fertilizers be used with safety?
5. Describe the value of nitrogen in producing growth of foliage.
6. What effect does phosphoric acid have on flowering plants?
7. What method of buying fertilizers is used in your community?
8. Discuss the possibility of buying fertilizers with other farmers.
9. How would you apply fertilizers to ornamental plants?

Composting Manure.—The most practical fertilizer used by growers is a good grade of compost. Compost of cow manure is very essential in preparing the soil for all pot plants. A good compost pile can be made by using trash, such as leaves, grass, etc., placed in a bin. Add a layer of the trash, a layer of cow or horse manure, and a layer of soil. These layers are repeated

until the compost heap is four or five feet high. The top layer should be arranged in basin effect in order to catch the rain. Decay can also be hastened by watering the compost heap. The pile may be cut with shovels and mixed after it is half rotted. Some growers mix superphosphate or rock phosphate along with the manure in making a compost heap. This adds plant food to balance the nitrogen of the manure.

Top dressings of strawy manure or rotted manure are often spread about ornamental plants in late fall and winter. This may be worked into the soil in the spring.

Commercial fertilizers may be applied as needed. In their application, special care must be taken to avoid burning tender plants. The best practice is to give frequent and light applications of quick-acting forms of nitrogen. Other fertilizers may be applied once a year, as early in the spring. The amount to apply depends upon the kind of plant and the kind of fertilizer.

Bulb Fertilizers.—Seven hundred to 1,000 pounds of bone meal per acre may be applied in the rows before planting. The next application of 600 to 800 pounds per acre is usually made two or three weeks later. These side dressings are such as would suit Irish potatoes. The second application should have less nitrogen, and more potash than the first.

Job 8. Cultivating and Caring for Plants

Conditions Usually Found.—Little cultivation is given to potted plants, but the outdoor nursery receives clean cultivation.

Aims.—Growers should understand cultivating, watering, potting, and stocking.

Problems for Study and Discussion

1. Describe the potting of cuttings.
2. Give purpose and describe re-potting of plants.
3. Give directions for watering potted plants.
4. Describe staking and supporting indoor plants; outdoor plants.
5. Describe cultivation of bulbs; of other outdoor nursery rows.

Activities.—Participate in all the operations of this job.

Potting Plants.—Cuttings should be potted just as soon as they have developed roots. The plants are usually put in small pots at first and then repotted as their growth demands. Avoid letting the plants become root bound. To repot plants, they should be watered thoroughly, and then a slight tap of the pot

will cause the soil and plant to slip out. It is best to change pots at least once a year after they are developed, as new soil may be added and the roots may be thinned and pruned if needed.

Watering Plants.—The most important point to remember in watering plants is never to allow the plants to dry out, as that checks growth and often causes damage to the foliage which cannot be overcome. Too much water will also damage plants. Facilities should be available for the plants to have proper drainage. Coarse gravel or broken pottery should be placed in the bottom of the pots. The soil for ornamental plants should be kept moist but not too wet. The usual practice is to give the plants some water each day, especially during the summer months.

Kind of Soil for Potting Plants.—The soil should be one that is easily drained and fertile. A good soil for this purpose may be made as suggested for making a compost heap. Use half soil and half compost. Another good soil for potted plants can be made by using equal parts of horse or cow manure, leaf mold, loam soil, and sand.

The cultivation of potted plants consists mostly in pulling grass and weeds out of the pots. It is a good practice to loosen the soil in the pots every few months and at least once every year the plants should be repotted. Using larger pots allows the addition of some fresh soil.

Cultivating the Nursery.—Plants grown in the open nursery should be given clean cultivation, as that for any of the field crops (Fig. 212). Special care has to be taken during the cultivation to prevent any injury to the growing plants. The cultivation should be deep in the early spring and shallow during the growing period. Weeds should be kept down without too much disturbance of nursery plant roots. (Fig. 213.)

Plants grown in pots during the early part of the season or during the winter are often set in nursery rows during the summer months. While growing out of doors, they should be given clean cultivation and should be properly managed to develop the buds and growth to suit special uses.

Cultivation of bulbs should begin as soon as the growth is well above the ground, and should be shallow. Root breakage should be avoided. Some growers prefer cultivating every other

row, thereby decreasing root breakage. Cultivation should be given as often as is necessary to control grass and weeds, and to maintain a dust mulch, and should continue until the bulbs show signs of ripening by the yellowing of the tops. During the cultivation period, while the plants are in full bloom, fields should be carefully rogued and all mixed and undesirable plants removed (Fig. 214).

FIG. 213.—A project in growing canna bulbs for market. Cultivation may cease after plants shade the soil. (Seaboard A. L. Ry.)

Job 9. Controlling Insects and Diseases

Conditions Usually Found.—The grower often has to fight enemies all the year.

Aims.—Students should be able to recognize and to treat all the important insects and diseases, and other enemies.

Problems for Study and Discussion

1. What are the insects in your community which are harmful to ornamental plants?
2. Learn to identify each of these insects.
3. What are the two common classes of insects?
4. How may each of these classes be controlled?
5. What diseases do you have to fight?
6. Give description of each of the important diseases.
7. How may these diseases be held in check?
8. Describe attacks of nematodes and suggest methods of control.
9. Describe the hot water treatment for bulbs.

Insect Enemies.—It is not necessary to name all of the insects which cause damage to ornamental plants. In general,

insects may be divided into two classes: sucking and biting.

The sucking insects include aphids, scale, and thrips. Such insects are controlled by contact sprays such as oil emulsion, concentrated lime-sulfur, and nicotine sulfate. Patent sprays are sometimes used.

Biting insects, or those which eat holes in leaves or destroy the foliage, are sometimes called chewing insects. Poisons may be dusted or sprayed on the plants. This will kill biting insects

FIG. 214.—Fields of gladioli. Left above, six weeks before blooming. Left below, about the right stage of bloom for cutting to ship, or perhaps too late. Main right, full bloom, a good stage for "roguing" the field.

which attack the plants. New growth should be kept protected with poison. Arsenate of lead and barium fluosilicate are good to use.

Plant diseases vary according to the different kinds of plants being grown. Some common diseases are rusts, mildews, wilts, and blights. Each disease is controlled in its own way, but most of them are controlled by a good fungicide, such as Bordeaux mixture or lime-sulfur. Bordeaux mixture is the most common fungicide used. (See Appendix.) Patent preparations are always on the market.

Spray Materials.—Home mixtures may be made and money saved where large quantities of spray materials are needed.

(See Apple Enterprises.) For small quantities it is usually best to buy spray materials from some reliable dealer.

Insects and Diseases of Bulbs.—Probably the worst enemy in bulb culture is the greater narcissus bulb fly, and similar flies attacking bulbs.

Nematode, or root knot, is also troublesome. Hot water treatment is recommended for this bulb fly and nematode control. The bulbs should be subjected at a temperature of 110 degrees F. for three hours.

The mealy bug is a troublesome storage insect. This is controlled by dusting with sulfur, nicotine dust, or by dipping in liquid nicotine sulfate. When a storage house is infested with mealy bugs, a rigid cleaning should be given. When infested bulbs are being forced indoors, the small insects may be found at the base of the foliage.

Job 10. Preparing Products; Marketing

Conditions Usually Found.—There are usually two general plans of marketing ornamental plants: (1) The grower sells to the local retail trade only and the people come for the plants. (2) He may sell to people at some distance, which requires him to ship the plants.

Aims.—Growers should understand the different methods of preparing products and of marketing them.

Problems for Study and Discussion

1. Describe the handling and marketing of cut flowers.
2. How are potted plants usually sold?
3. What plants need root protection by balling? Describe this.
4. Give directions for digging and sorting bulbs.
5. Why sell to users of nursery products instead of to dealers? Give the converse of this.
6. Selling through traveling agents vs. other methods.
7. Debate: Selling to retail trade vs. selling to wholesalers.
8. How could a coöperative organization aid in marketing nursery products?
9. What legal regulations control shipping nursery products?

Cut flowers are usually cut and gathered in the early part of the day while they are full of moisture, and the stems are placed in water. For the local retail trade many growers cut the flowers as they receive orders. If the flowers are to be shipped to market it is best to wrap the stems in damp sphagnum moss or lint cotton. Care should be taken to select only the best flowers and to cut the stems the same length. (Figs. 214 and 215.)

Potted plants for the local retail trade are usually sold in the pots, requiring no particular preparation for the market. If these plants are to be shipped, some kinds, as azaleas, dracænas, and roses, are sent with some soil packed in the burlap around the roots of each plant, and the whole plant is packed in damp sphagnum moss or some similar material. In some cases paper pots are used for plants that are to be shipped.

Ornamental shrubs or trees have to be dug carefully in order to prevent injury to the root systems. Many kinds of ornamentals, as palms, evergreens, and ferns, have to be shipped by surrounding the roots with a ball of soil held with some kind of

FIG. 215.—Cutting Dutch iris flowers for shipment to markets, Hanover Co., N. C. (Atlantic Coast Line Ry.)

coarse bagging material, as burlap. In all cases, care should be taken to prevent the roots from drying out.

Harvesting Bulbs.—As soon as the tops are dead the bulbs should be harvested. Beginning too soon weakens the bulbs. Waiting too long may allow a second growth to start, which ruins bulbs. Bottom decay may begin. Of the narcissus group, the Chinese Sacred Lily or Oriental Narcissus is earliest in ripening; this is followed by the Paperwhite, and finally by the Pearl White.

Digging is done with an ordinary machine potato digger or with potato-digging forks. Care should be exercised to avoid bruising, cutting, and fork-sticking. Immediately following the digging, the bulbs are picked up in baskets, buckets, or crates; the soil is shaken off well; and they are carried to a curing

shed. Great damage may result by exposure of bulbs to the sun more than a few hours after digging.

Bulbs are cured in open sheds which afford good circulation of air (Fig. 216). Bulbs may be placed in ventilated crates, or on shelves, not more than four to six inches deep. During the curing period the bulbs should be stirred once a week until dry to prevent heating. A period of three to five weeks, depending on weather conditions, is needed for drying. Bulbs harvested

FIG. 216.—Storage shed for bulbs. The racks are shallow and have ventilation space between.

during late May and early June are kept in storage until about the middle of September.

Sorting and grading of bulbs are done both by hand and by machine. Machine sizing is desirable and is the only safe standard under which bulbs are satisfactorily culled. Holland machines of the shaker type are preferred. Bulbs of irregular shape or otherwise defective are picked out by hand while the sizing machine is running.

The accepted commercial standards for blooming bulbs of the narcissus group are measured in centimeters: 12-13; 13-14; 15 and up. A bulb too large to pass through the 12-centimeter grader plate and easily passing through the 13-centimeter plate

is a 12-13, and so on for larger sizes. The smaller sizes are planted back in the fields, as nothing smaller than a 12-centimeter bulb is considered desirable for producing blooms of the best quality. Other planting stocks result from "splits," and from the small side bulbs branching from round and mother bulbs. (Figs. 209 and 210.)

Bulb Packing and Marketing.—No standard case is acceptable to all growers. The case most commonly used holds 1,000 of the 12-13 bulbs, 900 of the 13-14 bulbs, and 800 of the 15-up bulbs. The inside measurements of such a crate are approximately 30½ x 13 x 11 inches. The larger crate, 30½ x 14¾ x 14 inches, has been used in which to market the Chinese Sacred Lily and Soleil d'Or or the yellow Paperwhite, which bulbs are somewhat larger and coarser than the Paperwhite.

Southern grown bulbs are marketed throughout the country. The chain stores and the greenhouse trade serve as profitable outlets.

Marketing Other Ornamental Plants.—There are a number of methods of marketing ornamental plants: (1) The grower may contract with some wholesale firm or florist to grow plants at a stated price. (2) He may sell to the local retail trade. (3) He may sell to the distant retail trade by issuing catalogs or by having traveling salesmen. (4) He may sell to the wholesale trade but not under contract. (5) He may sell through organized marketing associations which handle ornamental plants.

There are probably some merits in each of these methods of marketing. However, the grower at first would probably do best to sell his plants under contract if such a market can be secured. It usually pays any grower of nursery plants to become affiliated with other growers in local, state, and national organizations.

Inspection.—Each state has laws relative to the inspection of ornamental trees and other nursery stock before they can be shipped. Usually an inspection tag is placed on each separate shipment. The purpose is to prevent the spread of dangerous parasites such as insects and plant diseases. Nurserymen must call for state inspection. They must be equipped with tight containers for treating plants by fumigation before shipment.

Job 11. Keeping Records

Nursery Records.—The regular forms shown in the Melon Enterprise should be used in keeping cost accounts, sales records, and in summarizing the business of any nursery. Records may be kept distinctly for any special part or parts of the business.

Activities.—Talk with growers of ornamentals and obtain data to fill out records for a year's work in growing and marketing one special line of ornamental plants.

Calculations.—1. The census of 1920 revealed a yearly income of approximately $62,000,000 from flowers and flowering plants, grown principally under glass. This was an increase of 122% in ten years. What would be the value of these products with like growth in 1930? 1940?

2. In a nursery project with hardy shrubs and vines a young man made 12,000 cuttings and grew two-thirds of them very successfully. By taking orders from local people he sold them at one year of age at an average price of $1.50 per 10 plants. Find his labor income if he did all the labor.

3. A young man planted one acre of narcissus bulbs as a project. The bulbs were planted at intervals of ¼ foot in rows 2½ feet apart. How many bulbs did he plant?

4. His costs for 2 years for stock, fertilizer, labor, and containers were $1,260. At the end of the time he had sold 100,000 blooming plants and blooms for $1,400, and invoiced his remaining planting stock and curing equipment at $700. He had not allowed anything for self labor. What was his labor income for the time spent on the project during the two years?

ENTERPRISES WITH ASPARAGUS PLUMOSUS

Collaborator: J. C. Brown, M.A., Teacher of Vocational Agriculture, Waynesville, N. C., Formerly Teacher of Vocational Agriculture, Barberville, Fla.

Analysis into Jobs.—An enterprise with this ornamental product includes the jobs given below. The product is often referred to as "asparagus fern," hence the name fernery for the place where plants are grown.

1. Determining possibilities with *Asparagus plumosus.*
2. Selecting the soil and locating the fernery.
3. Constructing a fernery.
4. Procuring and planting seed.
5. Setting the plants in the fernery.
6. Cultivating and fertilizing.
7. Controlling insects and diseases.
8. Harvesting, grading, and packing.
9. Marketing asparagus fern.

Job 1. Determining Possibilities with Asparagus Plumosus

Conditions Usually Found.—Asparagus fern requires special care and climatic conditions.

Aims.—The grower should understand the special requirements for asparagus fern, and consider all factors involved before undertaking this enterprise.

Problems for Study and Discussion

1. Where is asparagus fern grown on a commercial basis?
2. For what is asparagus fern used?
3. Discuss how much capital is required to start an acre fernery.
4. What is the annual cost for maintaining a fernery?
5. Estimate the average yield to expect per acre.
6. What is the average price to expect per crate?
7. Give the special labor requirements for asparagus fern.
8. What do growers say regarding the danger of over production in this line?

Description of Asparagus Fern.—The *Asparagus plumosus* is a climbing, much-branched semi-shrub. The main stem is very slender, wiry, smooth, and green. The branches and twigs are numerous. It has pseudo-leaves (needles) which are bristle-like, six to twelve together, and extremely fine.

Where Asparagus Fern is Grown.—The plant is native to southern Africa and was probably introduced into this country by some florist. There is little published concerning its growth either in this country or abroad. It is grown extensively in greenhouses in Switzerland, and up to a few years ago was found in northern greenhouses. In recent years, the plant has been grown in slathouses in Florida and in California. These states now produce probably two-thirds the entire crop. Texas is growing this product and is a close third.

The Use of Asparagus Fern.—It is very popular as decorative material. In the form of cut greens, it is used in making bouquets, garlands, and wreaths. It is used to decorate public buildings, to beautify our churches, to make bridal bouquets, or to make funeral wreaths. There is no floral decoration which cannot be improved by the pleasing green of asparagus fern.

Cost of establishing a fernery depends upon a number of factors. Under average conditions, however, one can construct the slathouse, buy the plants, and fertilize the crop one time for a cost of from $2,000 to $3,000 per acre. This cost depends upon the kind of slathouse and the method of planting. If good sawed lumber is used for the slathouse, the cost will not be less than $2,000 per acre.

Cost of Maintaining a Fernery.—This varies with the individual grower and with the type of slathouse constructed. The depreciation, taxes, and interest on investment may reach $350 to $450 per acre each year. The fertilizer may cost $200 to $250 per year. If there are no unusual outbreaks of insects or diseases, the cost of dusting and spraying materials is around $100 or $150 per year. The labor requirements are greater after the fernery comes into production. Ordinarily it requires approximately 2,100 hours each year per acre for a fernery more than three years old. The labor cost is not less than $400 per year. It is safe to say that few growers can operate an acre fernery for less than $1,000 per year, not including crates, ice, twine, or wrapping paper.

The plants will last as long or longer than the posts, if renewed about every six years, as described in Job 8.

Yields to Expect.—The fertility of the soil, the amount of fertilizer used, and the age of the fernery all affect the yields. Under average conditions, a fernery which is properly cared for

should yield an average of 10 to 15 crates per week. Of course, the highest yields come during the spring and summer months. During the fall and winter the yield may not be greater than 6 to 8 crates per week.

Prices.—Little can be given definitely concerning the prices to expect because of the different prices during the year. In some months a crate of 1,000 sprays may even fail to bring enough to pay express charges, yet there are times when such a crate has been known to bring $25. The average is somewhere between these two extremes.

Special Labor Requirements.—Hand labor is required constantly from the setting of the plants through each job done in the fernery. There are few tools adapted to the cultivation of a fernery. Weeds and grass have to be pulled by hand and thrown out. Fertilizer is worked into the soil with the hands in some cases, much as the housewife kneads dough.

Job 2. Selecting the Soil and Locating the Fernery

Conditions Usually Found.—Many growers pay too little attention to the selection of the proper soil and location for the fernery.

Aims.—How to select the soil and the location for the fernery should be well understood.

Problems for Study and Discussion

1. What kind of soil is used in your community for the fernery?
2. How much dry weather will asparagus fern stand?
3. How rich should the soil be?
4. How is organic matter provided? What are the dangers of having too much?
5. What drainage should be given a fernery?
6. Where would you locate a fernery?
7. How is the fernery protected from the cold?

Selecting the Soil.—As with various other crops, *Asparagus plumosus* will grow on a variety of soil types. It probably does best, however, on a clay loam mixed with well-rotted leaves, manure, and sand. The type of soil usually selected in Florida is known as scrub oak soil, a soil upon which there is a growth of scrub (black jack) oaks. This soil is usually a light sandy soil underlaid with yellow sand. Soils too rich in nitrogen should be avoided, because of the tendency of the fern to "run up" and produce heavy, dark green sprays. Do not use muck soil. The grower should be able to control the nitrogen supply at all times.

High pine land may be used where the scrub oak soil is not available.

Moisture Requirements.—This plant is able to withstand severe dry weather but it is not advisable to plant it on "thirsty" soils. It is doubtful if it would be profitable to undertake growing this crop on soils so wet that drainage is necessary.

Location of Fernery.—The growers should guard against locating the fernery in a bottom no matter how favorable the other conditions may be. It has been shown that such a location is colder than on a slope. Due consideration should be given to natural windbreaks. If the fernery can be located so as to have a body of timber to protect it from the prevailing winter winds, this may be of great help in protection from cold. If the fernery is located near the trees, it will be necessary to dig a trench from three to four feet deep next to the fernery to cut the feeding roots of the trees.

The hot summers and heavy rains seem to affect the quality of the fern as much as does the cold of winter. The combination of heat and rain scalds the sprays, causing them to turn yellow and shed. For these reasons, it is very desirable to locate a fernery near a body of water. Locate the fernery on the leeward side of the body of water. The water warms the winds in winter and cools them in summer.

Protecting the Fernery from Cold.—Fern is affected by both cold and heat. A temperature of 26 degrees F. does not injure a fernery unless it lasts for two to four days, but a temperature of 18 degrees for only a few hours kills back the growth; however, the roots may not be killed.

The height of the top of the fernery has much to do with the temperature. One grower had a fernery which was constructed five and one-half feet high and another fernery just next to it constructed seven feet high. The fernery with the low top was affected by frost in winter while the other one was not.

With all precautions that can be taken into consideration in constructing a fernery, in most locations it will be necessary to furnish artificial heat during severe cold snaps in the winter. Heat is usually furnished by coke heaters placed about thirty feet apart. These heaters are suspended from the top of the fernery by wires. They should be placed over the walks rather than over the beds. The heater should be about eighteen to

twenty-four inches above the plants. The object of the heat is to prevent the formation of frost.

Job 3. Constructing a Fernery

Conditions Usually Found.—Many growers fail to build the fernery high enough and to use good material in building it.

Aims.—Growers should understand how to determine the material to use in constructing a fernery, and how to construct one.

Problems for Study and Discussion

1. How many posts would you need for an acre fernery?
2. What kind of posts would you want for your fernery?
3. Of what sizes should the posts be?
4. What lumber would you use for the top? Give dimensions.
5. What material is used for the side walls?
6. Figure whether it would be cheaper to build a square or a rectangular fernery.
7. How high would you build the fernery?

Activities.—Draw plans for a fernery, and make a bill of materials. Visit several ferneries and study the construction used. If possible, assist in the building of a fernery.

Material for Fernery.—The following bill of material should construct a slathouse one acre in size (Figs. 217 and 218):

756 posts, 9 feet long
100 pounds of 20d nails
300 pounds of 8d nails
4,600 linear feet, 2 x 4 No. 1 pecky cypress for the stringers
14,000 linear feet, 1 x 4 No. 2 pecky cypress for top
12,000 linear feet, random width boards, No. 2 pecky cypress, for sides

Preparing Soil Before Building.—Before the fernery is constructed the soil should be plowed about six inches deep, and disked or harrowed several times in order to bring it into a stage of good tilth. This breaking should be done a month or two before planting season. At the time the soil is prepared, a ton or a ton and a half of goat or sheep manure should be broadcast and worked into the soil. Sometimes cow manure is used. A crop of cowpeas may be grown on the soil just prior to breaking it for the fernery. This growth is turned under as green manure.

Constructing the Fernery.—The posts are set eight feet apart each way and, in case beds are used, the posts should be placed in the middle of the bed. Posts are set deep enough in

the ground for them to be steady and so that they extend about six or seven feet high. If the stringers (2 x 4 inches) are to be set on top of the posts, the posts should be eight feet long and set two feet in the ground. If the stringers are nailed to the sides of the posts, the posts should be nine feet long and placed two feet deep.

The stringers should be sixteen feet long so they can meet at every second post, or they may lap at random. If the stringers are not cut exactly the right length, they should be recut to pre-

FIG. 217

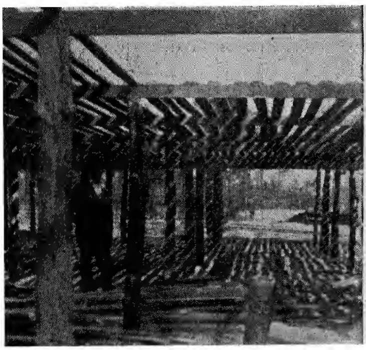


FIG. 218

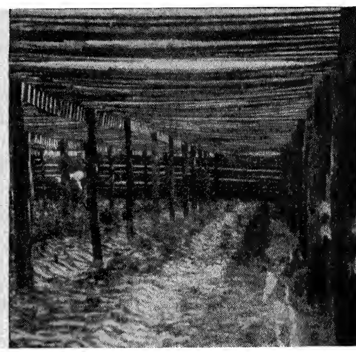


FIG. 217.—Fernery in process of construction. (J. C. Brown.)
FIG. 218.—Fernery after plants have been growing three months. (J. C. Brown.)

vent pulling the posts out of line. The stringers should run east and west so that the top slats, when nailed on, run north and south. The beds or rows of plants should run in the opposite direction from the top strips, so that the shade travels as the sun goes over. If the beds run in the same direction as the top strips, some plants are shaded all day and others are in the sun all day.

Narrow paths are placed about six feet apart running the long way of the fernery. After the stringers are nailed to the posts the top is ready to go on. The top is constructed with pieces 1 x 4 or 1 x 3 inches. The amount of shade wanted determines the distance between boards. Tops are constructed so as to give either "one-half" or "two-thirds" shade. The three-inch strips are placed 1 or $1\frac{1}{2}$ inches apart. The four-inch strips are placed

$1\frac{1}{3}$ or 2 inches apart. The "two-thirds" shade is commonly used with the closer spacing.

The side walls of the fernery may be constructed out of random width boards or any kind of scrap lumber. Boards may be placed vertically or horizontally. Double doors should be made where they will be most convenient for the grower.

A good packing shed should be made near the entrance to the fernery. This is used in packing shipments. It should have a good roof and may be provided with a chimney and stove if desired.

Job 4. Procuring and Planting Seed

Conditions Usually Found.—Some growers depend upon buying the seed and growing their plants. Others buy the plants.

Aims.—Where to procure the seed and how to plant them should be understood by the grower.

Problems for Study and Discussion

1. From what sources may seed be obtained?
2. What is the usual price per pound for the seed?
3. How much seed will be needed to produce plants for an acre?
4. How would you prepare the bed for planting seed?
5. When would you plant the seed?
6. What fertilization and care would you give the young plants?

Choosing the Variety.—There are several different varieties of asparagus fern. The *Asparagus plumosus nanus* is the variety which is usually grown. Some few growers plant the *Asparagus plumosus tenuissimus,* which has somewhat longer leaves than the other variety. *Asparagus sprengeri* is coarse, and is often grown in hanging baskets. It is little used for decorative purposes.

Where to Secure Seed.—As it is impractical to grow seed in southern states, the seeds for *Asparagus plumosus* may be ordered from Switzerland or from California seedhouses. Dealers in New York may supply seed. Names of seedhouses which sell these seeds may be obtained from the *Florist Review* or from the State Bureau of Markets.

Amount of Seed to Buy.—*Asparagus plumosus* seed sells for \$6 to \$10 per pound, depending on the supply and the demand. The common method of planting requires 40,000 plants to the acre. There are approximately 10,000 seed to the pound, but the germinating power is usually low as compared with other

seeds. The general practice is to purchase six pounds of seed to secure plants for an acre. Some growers use eight pounds when prices are reasonable.

Preparing the Seed-Bed.—One of the best plans is to prepare soil where a fernery is to be located. Make a fine seed-bed as for vegetable gardens. It requires about 1,000 to 1,200 square feet to give enough space to grow plants to set an acre area in a fernery.

Planting the Seed.—The chief planting is done about the middle of March or in August or September. All growers agree that March is the best time. The seed is sown in rows eight or ten inches apart and dropped at the rate of two to the inch. The seed is covered with about one inch of soil, and then the bed is covered with Spanish moss or old sacks which have been thoroughly washed free from fertilizer. Keep the moss over the soil until the seed begin to sprout.

Caring for the Seed-Bed.—Never fertilize the seed-bed before planting. It takes from four to five weeks for the seed to germinate. Pull out weeds and grass just after the young plants come up. After the plants are three or four weeks old they make better growth if an application of nitrate of soda or urea is applied. Use one teaspoonful of urea powder or three teaspoonfuls of nitrate of soda to the gallon of water and sprinkle this over a hundred square feet of area. In either case, sprinkle the plants immediately with plain water to prevent burning. The plants may be fertilized in this manner every sixty or seventy-five days, depending upon the color of the foliage. They are rather slow in growing and should not be forced too rapidly.

Under ordinary circumstances the plants will get plenty of water from rainfall. In extremely dry weather some water may be applied. A stocky, hardy plant can be produced better in somewhat adverse rather than in ideal conditions, as very tender growth may be stunted at transplanting time.

Buying Plants.—Some growers prefer to buy plants instead of growing them from seed. This method saves much time but adds greatly to the expense. More capital is required for starting this enterprise. The plants may be purchased from other growers at prices ranging from $9 to $15 per thousand. If 40,000 plants are used per acre the expense is worth considering.

Job 5. Setting the Plants in the Fernery

Conditions Usually Found.—Plants are set by hand in the fernery. Some growers put out plants at the wrong time.

Aims.—How to set out fern plants and manage the young plantation should be understood.

Problems for Study and Discussion

1. How many plants are needed for an acre?
2. Show relation of care in setting to price of plants.
3. When is the best time to set out the plants?
4. At what distances are plants usually set?
5. How often would you water the plants after setting them?
6. Describe local methods of setting and caring for fern plants.
7. Debate: Level vs. ridge setting of plants.

Size of Plants to Use.—Growers agree that plants grown for one year in the plant-bed are to be preferred to the six-months-old plants. The six-months-old plants, however, are better than the over-large one-year-old plants. An ideal plant is one grown in the seed-bed for a year and which has spindling growth with little foliage but a heavy root system. The root development has more to do with the value of a plant than the top growth. The main objection to the small plants is that they have to be "dug" out of the soil after each hard rain.

Setting the Plants.—Different distances for setting plants are used by individual growers. The most common plans are to have eight-inch rows and plants set ten inches apart in the rows or just the opposite of this. A good plan is to use a wheel hoe or other marker to lay off the rows in both directions. The soil should be opened a few inches by the marker. The plants are then set at each intersection of the marks or shallow furrows.

They should be set at the same depth at which they grew in the nursery. The hole for planting may be made with the hand or with a dibble. In planting, the roots should be spread out and worked into the soil without bending them upward. Work the soil around the roots and pack with the hand.

Watering.—Unless the ground is wet before setting the plants, the young plants should be watered every week for the first month. If the water is under pressure, it will be necessary to shake the dirt off the foliage after each watering. In case of very hard rains, it will be necessary to dig the foliage out of the soil. After the plants are a year old the dirt may be brushed off with a broom. To leave the plants covered with soil will

cause a discoloration of the foliage and eventually a shedding of the leaves.

Job 6. Cultivating and Fertilizing

Conditions Usually Found.—Hand cultivation is most common. Few growers know how properly to fertilize the asparagus fern.

Aims.—How properly to cultivate, weed, and fertilize the crop for best results should be understood.

Problems for Study and Discussion

1. What tools will aid in tilling the plants?
2. Describe methods of tilling and weeding soil.
3. Describe methods of watering.
4. What fertilizer is being used in your community for fern?
5. When and how would you apply the fertilizer?
6. What are the advantages of organic nitrogen?
7. How much compost would you use per acre?

Cultivating the Fernery.—The purpose of cultivation is to keep the weeds and grass out of the fernery and to conserve moisture. The most satisfactory way to keep the grass and weeds out is to pull them by hand and put them in the walks or throw them out of the fernery. If they are left on the beds, the first rain may cause them to grow. While the plants are small the soil should be worked with the hands at the time the grass is pulled. The most satisfactory way of working the soil is with the fingers, because no tool has been devised which will stir the soil and not injure the roots. Some growers use a one-hand scratching tool to some extent.

Mulching.—Some growers use a mulch of leaves or straw or peat on the beds to conserve moisture and to keep down weeds. Leaves are sometimes used in the walks for the same purpose but this practice is of doubtful value on account of insects hiding in the leaves.

Treatment of Old Ferneries.—After a fernery has covered the ground there is no cultivation that can be given. When the plants are about six years old it is a good plan to take a few beds each year and cut the plants back to the ground. The roots should then be worked loose with a pitchfork or some similar tool. After this is done then apply a ton of tobacco stems. The whole fernery should not be treated in this manner at the same time because it will take from six to eight weeks before shipping may be resumed. This operation should be done in July in order that the grower may ship in the fall when the

price is high. This same treatment, except the root disturbance, should be given in case of a severe freeze.

Fertilizing Asparagus Ferns.—There have been few if any scientific tests completed to determine the best fertilizing practices. The crop requires a complete fertilizer. The one in general use is a 5-5-5 (N-P-K). The nitrogen content should be increased to about 7 per cent in the winter. The plants are more subject to frost when in active growth but this is the time of the year when prices are high. Fertilizer that has proven satisfactory is made from high-grade tankage, goat or sheep manure, castor pomace, sulfate of ammonia, nitrate of soda, superphosphate, steamed bone meal, and sulfate of potash.

Kainit, if used, should be applied in a mixture, but hardwood ashes may be applied as a separate fertilizer. Some growers have good success by using tobacco stems, tankage, and castor pomace separately, applying a ton of each one after the other, every ninety days.

Applying Fertilizers.—The rate of the application of a complete fertilizer should be from 1,500 to 2,000 pounds to the acre every sixty or ninety days. The grower should be guided by the color and growth of the plants. For young plants the fertilizer should be scratched into the soil and the tops sprinkled with water to prevent burning. In old ferneries, all that can be done is to apply the fertilizer and wash off all that falls on the tops. Fertilizer should be brushed off the plants with some kind of broom unless watering with a hose and good pressure is possible.

Organic Manures.—There are several forms of peat on the market which may be used for this crop. Cow manure has proven to be one of the best fertilizers for this crop. The only objection to it is that many weeds are usually introduced into the fernery and, if used alone, it tends to produce coarse growth.

Job 7. Controlling Insects and Diseases

Conditions Usually Found.—Growers have to combat several enemies of asparagus fern.

Aims.—How to identify each disease and insect enemy and how to control each should be understood.

Problems for Study and Discussion

1. List the disease and insect enemies of asparagus fern found in your community.
2. Identify each of these enemies.

3. Give the control measures for each of these enemies.
4. What spray materials and equipment would a grower need?

Insect Enemies.—Asparagus fern is attacked by two species of red spiders. One is extremely small and is properly designated as "spider mite." The fully grown individual is about one-fiftieth of an inch long and about half as wide. It is of a reddish color, frequently tinged with yellow, green, or orange. The body has two dark spots, one on each side. It does its damage by sucking the plant juices from the plant, causing the plant to wither, especially at the tips. This insect causes considerable damage and no effective control measures have been found. Mites thrive better in dry, hot weather. Rain and irrigation have proved to be valuable in helping to keep them in check.

The other species of red spider is larger than the first one mentioned and is reddish in color. The damage is practically the same for both species, but fortunately this species can be easily controlled by dusting with dry sulfur or spraying with a weak summer solution of commercial lime-sulfur.

It is a very good practice to dust with sulfur each month whether or not there is any sign of red spiders. This is more necessary during the summer months than during the winter. Sulfur does not discolor the plants in summer as sprays sometimes do.

Caterpillars.—Several kinds of caterpillars attack the crop. They may be controlled by spraying with arsenate of lead, one pound to fifty gallons of water.

Crickets and grasshoppers are troublesome during the late summer and early fall. The spray or dust poison used for caterpillars is also a protection against crickets and grasshoppers. These may be controlled by poisoned bait, provided there is no mulching system practiced. The bait is as follows: bran, 20 pounds; Paris green, 1 pound; syrup, 2 quarts; 2 lemons; water, 2½ gallons.

Aphids also do considerable damage to this crop by sucking the juice from the plants. They may be controlled by a thorough spraying with nicotine sulfate, one pint to thirty gallons of water. In spraying it is essential that both the top and the under side of the leaves be sprayed.

Diseases.—So far, no fungous diseases have troubled the crop. There is a condition which causes the tops of the plants to turn yellow and shed. This condition is usually caused by intermittent rains and hot weather. There is no treatment for this; however, dusting with sulfur seems to help to some extent. Do not spray with Bordeaux mixture as the material discolors the foliage.

Job 8. Harvesting, Grading, and Packing

Conditions Usually Found.—Tops are cut by hand, during every month of the year. Little grading is practiced. Several sizes of crates are used for packing.

Aims.—How to tell when to harvest the crop and how to cut, grade, and pack the sprays should be understood.

Problems for Study and Discussion

1. At what age should sprays be cut?
2. What different practices are needed for the different markets?
3. What tools are needed in cutting the sprays?
4. Describe methods of cutting ferns.
5. Describe the grading of sprays.
6. Describe crates to be used.
7. How are the sprays packed?
8. How are bunches kept fresh during shipment?

Activities.—Practice harvesting, grading, and packing until the details are learned.

What Sprays to Harvest.—Specific directions as to when the crop is ready to cut cannot be given. Practice is the only way to learn that. Different buyers insist on different shades of green, length of sprays, and different degrees of maturity. It is safe to say that a spray should not be cut which has not filled out well at the tip. These sprays which have not unfolded at the tip should be left until later. Usually a medium green color is what is wanted by most buyers. If the fern is too old it will shed its "feathers" before reaching the market. Contact with the market requirements and methods used by the best growers will soon teach a grower the type and kind of sprays to cut. The shipment will then sell more readily.

Cutting the Sprays.—Harvesting is done by clipping the stalks of the sprays at or near the ground, the longer the sprays the better. If the sprays are cut several inches above the ground new shoots are likely to start and produce short sprays.

Bunching.—As the sprays are cut they are tied into bunches of uniform size of about ten to twenty-five sprays and placed in the walks. These bunches are collected and then prepared for market.

Grading.—There are no market grades of asparagus fern which have been accepted as standard. Each grower has his idea of what the grades should be. Some growers make no attempt at grading, while others grade as they think best for the market. As long as buyers do not complain about the quality, grading will not be practiced by all growers. There is no doubt, however, that a properly graded shipment, even if every grower does have a different idea of grading, will bring better prices on the market than will sprays of all lengths and colors packed together.

Packing.—Every grower seems to have a different method for packing the bunches. The following method is probably one of the best: After the bunches are brought into the packing house they are washed and all discolored "feathers" removed. Five bunches are tied together which make a "clump" of 125 sprays. Six of these clumps are packed into a crate.

Before being packed, the ends of the stems are cut even and a small handful of damp sphagnum moss is wrapped around them. Several layers of newspaper are wrapped around the moss and tied so as not to slip off easily.

In packing, start at one end of the crate, laying the butts to the end of the crate and the next layer in the opposite way, and so on until the crate is filled. The tops may have to be bent to make the ends fit in the crate. In some cases, ice may be put in the center of the crate. Use about 15 pounds of ice and wrap it in newspaper. The sizes and capacities of crates range from 24 x 11 x 10 inches to 34 x 18 x 18 inches, but the method of packing is the same.

Some growers practice cutting in the afternoon and let the ends stay in water over night, while other growers pack and ship immediately. If the sprays are shedding, they may be dipped, before they are packed, into a solution of lime-sulfur, one part of the concentrated solution to one hundred parts of water. This prevents some shedding but causes the sprays to assume a dull color and is considered to be a poor practice. The best growers seldom use this method.

Job 9. Marketing Asparagus Fern

Conditions Usually Found.—Growers usually sell through commission merchants or direct to florists. Some very poor methods of marketing are practiced.

Aims.—The best methods of marketing the crop should be understood and followed.

Problems for Study and Discussion

1. How is asparagus fern sold from your community?
2. What value could there be in a system of coöperative marketing?
3. What use do you see in obtaining contracts to furnish so much asparagus fern per month?
4. In what ways do growers find a new market for their crop?
5. What are some of the best markets for this crop?

Systematic Marketing of Asparagus Fern.—The markets of America have seldom been over-supplied by the shipments of this crop. The markets which are good, however, at present seem to be fairly well supplied. The growers have been slow to coöperate in marketing. There are no systematic methods of marketing the product from Florida. Several attempts have been made to organize but so far a plan has not been perfected. If the growers were organized and the inferior grades kept off the market, better prices could be secured. With the proper advertising of the crop, in such an organization, a demand could be created for more than is now being produced.

Methods Followed.—All except a little of the product, which is shipped direct to florists, is sold through commission merchants in the large cities. Most commission men are honest, but some are at least indifferent to the best interests of the growers. A grower should never ship in quantities until he has previously ascertained whether or not that particular commission man can handle his product. It is the practice of some growers to get the address of commission merchants and ship a crate or two without any correspondence. This usually gives bad results. If the grower knows the commission firm to be a good one he may ship one crate as a sample.

Many of the successful growers have contracts to furnish certain quantities of asparagus fern to florists each week at stipulated prices. A grower is certain of the price he is to receive and is assured of a market. The market price may be much higher or lower at times than the contract price.

Asparagus Fern Calculations.—1. Determine at current prices the costs of a list of materials for a slathouse covering one acre: (a) the posts; (b) the 2 x 4 stringers; (c) top strips 1 x 3 inches spaced an inch apart; (d) side strips and boards as given in text; (e) nails for the whole job.

2. Find the number of plants for an acre fernery set 8 x 10 inches.

3. Find the cost of such plants at $9 a thousand.

4. A grower applied a ton of commercial fertilizer every ninety days on an acre fernery. The fertilizer was mixed each time from the following materials:

100 lbs. sulfate of ammonia
400 lbs. castor pomace
400 lbs. sheep manure
100 lbs. fish scrap
200 lbs. high grade tankage
600 lbs. 16% superphosphate
200 lbs. sulfate of potash

Determine the cost of each application at current prices.

5. Determine the cost for fertilizing the fernery for a year.

6. A grower spent $2,000 to establish his acre fernery and $1,000 per year for fertilizer, spray materials, and labor. His fernery produced an average of 10 crates (750 sprays each) per week, which brought $6.50 net per crate, after paying for crates, ice, twine, and wrapping paper. What was his net profit if interest on investment is charged at 10%?

APPENDIX

PROVIDING BULLETINS

Each student should write to the Superintendent of Documents, Government Printing Office, Washington, D. C., for a list of available publications of the U. S. Department of Agriculture, particularly "Farmers' Bulletins." Then order those publications which suit local conditions. Each student should start a

FIG. 219.—Future Farmer of America in his home-study office, among his first accumulated possessions—books, bulletins, and records.

library at home and keep pamphlets in neat pamphlet holders (Fig 219).

See the special books and bulletins mentioned for each enterprise and get them.

State Experiment Station Bulletins should be obtained and arranged by enterprises. Addresses for twelve southern Stations are as follows:

Ala.—Auburn
Ark.—Fayetteville
Fla.—Gainesville
Ga.—Athens
La.—Baton Rouge
Miss.—State College
N. C.—Raleigh
Okla.—Stillwater
S. C.—Clemson
Tex.—College Station
Tenn.—Knoxville
Va.—Blacksburg and Norfolk *

LIBRARY BOOKS

Orcharding and Small Fruits

Auchter and Knapp, *Orchard and Small Fruit Culture* (Wiley, 1929), $5.
Bailey, *Nursery Manual* (Macmillan, 1920), $2.50.
Card, *Bush Fruits* (Macmillan, 1925), $2.50.
Chandler, *Fruit Growing* (Mifflin, 1925), $5.
Frazier, *Strawberry Growing* (Judd, 1927), $1.25.
Folger and Thomson, *Commercial Apple Industry* (Macmillan, 1921), $3.
Gardner, Bradford and Hooker, *Orcharding* (McGraw, 1927), $3.
Gould, *Peach Growing* (Macmillan, 1918), $2.50.
Hedrick, *Grape Growing* (Macmillan, 1924), $2.50.
Hume, *Citrus Fruits* (Macmillan, 1926), $3.
Sears, *Small Fruits* (Lippincott, 1925), $3.
Sears, *Productive Orcharding* (Lippincott, 1927), $3.
Sears, *Fruit Growing Projects* (Macmillan, 1928), $1.80.
Shoemaker, *Small Fruit Culture* (Blakiston's Son, 1934).
Stuckey and Kyle, *Pecan Growing* (Macmillan, 1925), $3.
Van Meter, *Bush Fruit Production* (Judd, 1928), $1.25.

Vegetable Crops

Freeman, *Home Vegetable Garden* (Macmillan, 1922), $1.75.
Hand and Cockerham, *Sweet Potato* (Macmillan, 1921), $2.50.
Hume, *Gardening in the Lower South* (Macmillan, 1927), $3.
Jones and Emswaller, *The Vegetable Industry* (McGraw-Hill, 1931).
Knott, *Vegetable Growing* (Lea-Febiger, 1930), $3.25.
Lloyd, *Productive Vegetable Growing* (Lippincott, 1930), $3.
Stuart, *The Potato* (Lippincott, 1928), $3.
Thompson, *Vegetable Crops* (McGraw, 1931), $4.50.
Thompson, *Sweet Potatoes* (Judd, 1929), $1.25.
Watts, *Vegetable Gardening* (Judd, 1922), $2.50.
Wallace and Bressman, *Corn Growing* (Wiley, 1928), $2.50.
Ware, *Southern Vegetable Crops* (American, 1938), $4.

Ornamentals, Flowers, Bulbs

Bennett, *Roadside Developments* (Macmillan, 1929), $5.
Bottomley, *Design of Small Properties* (Macmillan, 1926), $5.
Cotter, *Rock Gardens* (Macmillan, 1926), $1.
Fox, *Patio Gardens* (Macmillan, 1929), $6.
Poole, *Flowers and Flowering Plants* (McGraw, 1929), $2.50.
Rockwell, *Book of Bulbs* (Macmillan, 1927), $3.
Stevens, *Garden Flowers in Color* (Macmillan, 1936).
Thayer, *Spring Flowering Bulbs* (Judd, 1928), $1.25.

* State truck crop station.

VOLZ, *Home Flower-Grower* (Macmillan, 1928), $3.50.
WAUGH, *Everybody's Garden* (Judd, 1930), $3.
WAUGH, *Hardy Shrubs* (Judd, 1928), $1.25.
WAUGH, *Book of Landscape Gardening* (Judd, 1926), $2.

Diseases, Insects, Spraying

CHUPP, *Diseases of Garden Crops* (Macmillan, 1925), $5.
FAWCETT AND LEE, *Citrus Diseases* (McGraw, 1926), $5.
HEALD, *Manual of Plant Diseases* (McGraw-Hill, 1933), $7.50.
MASON, *Spraying, Dusting and Fumigating* (Macmillan, 1928), $5.
RANKIN, *Tree Diseases* (Macmillan, 1918), $3.25.
SANDERSON AND PEAIRS, *Insects of Farm, Garden and Orchard* (Wiley, 1921), $4.50.
SLINGERLAND AND CROSBY, *Fruit Insects* (Macmillan, 1914), $3.50.
WASHBURN, *Injurious Insects* (Lippincott, 1918), $3.

Weeds

GEORGIA, *Manual of Weeds* (Macmillan, 1914), $3.

Marketing

BOYLE, *Marketing Agricultural Products* (McGraw, 1925), $3.50.
CLARK AND WELD, *Marketing Agricultural Products* (Macmillan, 1932).
MCKAY AND LANE, *Cooperative Marketing* (Wiley, 1928), $3.
MEANS AND TABRINER, *Coöperative Marketing* (Ginn, 1926), $3.20.
OVERTON AND ROBERTSON, *Farm Management and Marketing* (Lippincott, 1936), $2.
SHERMAN, *Merchandising Fruits and Vegetables* (McGraw, 1929), $4.
WATTS, *Roadside Marketing* (Judd, 1928), $1.25.

Soils and Fertilizers

HINKLE, S. F., *Fertility* (Pub. by author, SANDUSKY, O.), $2.85.
WEIR, *Soil Science* (Lippincott, 1936), $3.
WORTHEN, *Farm Soils* (Wiley, 1935), $2.75.

Farm Shop and Mechanics

FIELD, OLSON, NYLIN, *Farm Mechanics* (Century, 1928), $2.50.
ROEHL, *Farmer's Shop Book* (Bruce, 1923), $3.
SMITH, *Agricultural Mechanics* (Lippincott, 1925), $3.
SMITH, *Farm Machinery and Equipment* (McGraw-Hill, 1937), $3.25.

General and Miscellaneous

BAILEY, *Standard Cyclopedia of Horticulture* (Macmillan, 1925), 3 vols., $25.
GETMAN, *Future Farmers in Action* (Wiley, 1929), $1.50.
LLOYD, *Studies in Horticulture* (Rand, 1924), $2.25.
STUCKEY AND MATTHEWS, *Horticulture* (Smith-Hammond, 1927), $2.

INSECTICIDE AND FUNGICIDE FORMULAS

Poisons for Biting Insects

1. **Arsenate of lead** (powder): on apple, 1½ pounds and 2 pounds lime to 50 gallons of spray; on peach, 1 pound and 2 pounds lime to 50 gallons of spray.
2. **Arsenate of lead** to be dusted on garden and orchard plants, 1 pound powder to 6 to 10 pounds lime dust, sulfur, etc.
3. **Paris green:** spray, 4 to 6 ounces and 1 pound lime to 50 gallons; dust, 1 pound to 20 pounds lime dust.
4. **Arsenate of lime:** use when recommended as dust or as spray in same strengths as arsenate of lead.
5. **Arsenate of zinc** is to be used one-third as strong as arsenate of lead and only with sprays containing lime to prevent burning of foliage.
6. **Barium fluosilicate (cryolite)** is used at the same rates as arsenate of lead, in spraying to poison bean beetles and other biting insects. It is not dangerously poison to human beings. Use one part with two parts of lime for dusting. (Tenn. Bul. 120.)

Contact Sprays for Sucking Insects

7. **Kerosene emulsion:**

Strong hard soap, shaved fine	½ pound
Water	1 gallon
Kerosene or crude petroleum	2 gallons

Dissolve soap in boiling water and add other parts. Agitate violently while hot. Use 1 part to 15 of water in spraying.

8. **Home-made oil emulsion:**

Strong potash soap	1 pound
Water	1 gallon
Good auto-engine oil	2 gallons

Dissolve soap in hot water and boil all the ingredients together until brown scum disappears. Pump into second vessel and back again while hot. Use 3 gallons of this solution to 100 gallons of water for winter spraying.

9. **Nicotine sprays:**

Nicotine sulfate solution	1 part
Water or spray mixtures	800 to 1000 parts

10. **Tobacco decoction:**

Tobacco stems	1 pound
Boiling water	1 gallon

Boil together for one hour and strain before spraying; add water to make 2 gallons.

11. **Commercial lime-sulfur** in liquid should be diluted as follows according to the test with Baumé hydrometer:

Baumé reading	*No. parts water to add for each part of lime-sulfur* — *Winter spray to test 5° B.*	*Summer spray to test 1° B.*
33	7	40
32	6½	38
31	6	36⅓
30	5½	34¾
29	5¼	33⅓
28	5	32
27	4¾	29⅔
26	4½	28½
25	4¼	26⅔
24	4	25⅔
23	4	23½
22	3¾	22¼
21	3½	20½
20	3	19

12. **Home boiled lime-sulfur,** common formula:

Powdered flowers of sulfur	30 pounds
Fresh burned stone lime	15 gallons
Water about	15 gallons

Make as directed for No. 11, and test before using. Lime-sulfur preparations may be stored if covered with oil to prevent evaporation.

13. **Commercial wettable sulfurs**

Wettable sulfurs, so named because they carry wetting agents consisting of chemicals that will cause the sulfur to disperse in water, have replaced self-boiled lime sulfur and dry-mix sulfur lime sprays for the spraying of peaches and to a certain extent other stone fruits for brown rot control. Many apple growers also are using wettable sulfurs in summer applications when bitter rot or apple blotch is not a factor.

On peaches, usually two pounds of wettable sulfur are added to fifty gallons of water. Wettable sulfur leaves such an indistinct residue on the fruit that it may be applied to peaches during the harvest season to prevent brown rot. About three pounds normally are used in fifty gallons of spray for plums.

14. **Home mixed wettable sulfurs**

For commercial acreages of fruit the grower may be able to save money by preparing wettable sulfur from a fine grade of dusting sulfur. Certain chemical wetting agents can be purchased which can be mixed with the sulfur in a mixing pail or in the spray tank. Write to the Agricultural Experiment Station for information on this subject. Use only the finest grades of dusting sulfur for the home mixing of wettable sulfur.

15. **Powdered lime-sulfur** is sold in commercial form on the theory that it will save shipment of water. But the prices show it to be much the most expensive form to use. Some of its preparations are not effective in recommended strengths against San José scale.

Fungicides for Plant Diseases

16. **Bordeaux Mixture**, common 4-6-100 formula:

Copper sulfate powder	4 pounds
Hydrated lime	6 pounds
Water	100 gallons

When powdered copper sulfate is used, the bordeaux mixture can be made in the spray tank without the necessity for preparation of stock solutions of either copper sulfate or lime. With the agitator blades partially covered with water, start engine to provide agitation. Sift into the tank the required number of pounds of the copper sulfate which should dissolve immediately. Continue to fill tank with water and when one-third or more filled, sift in the hydrated lime which should be of the finest grade. Continue agitation until spray is applied to the trees.

17. **Formaldehyde fumigation:**

Formalin, 40 per cent strength	3 pounds
Potassium permanganate	23 ounces

For 1,000 cubic feet of space in a tight room. Used for potatoes, onions, etc., in storage. Put materials in flat, open vessels on floor, leave promptly, and close all openings well.

18. **Combining spray materials :**

Add poisons at recommended rates to Bordeaux mixture or to lime-sulfur instead of to water. Nicotine sulfate may be added to Bordeaux mixture in like proportion as to water.

19. **Combining dust materials:**

Hydrated lime	15 parts
Arsenate of lead	5 parts
Sulfur	80 parts

20. **Seed treatments:**

a. Semesan (Geneva Station Bul. 554).

Semesan (35% mercury-chlor-phenol-sulfate)	1 ounce
Water	1½ pints

Soak all kinds of seeds one half to one hour before planting, to kill seed-borne diseases and to improve germination.

b. Corrosive sublimate

Corrosive sublimate (bichloride of mercury)	1 ounce
Water	8 gallons

c. Formaldehyde

Formalin (40% strength)	1 pint
Water	32 gallons

Soak seed potatoes for one to two hours.

POISONED BRAN BAIT

(For Cutworm, Army Worm, and Grasshopper Control)

There are several poisoned bait formulas in use. The Department of Agriculture (Farmers' Bulletin 731) recommends the following:

Wheat bran	50 pounds
Paris Green or crude arsenic	2 pounds
Blackstrap molasses	2 quarts
Water	6 gallons

Thoroughly mix, while dry, the bran and Paris Green, or bran and arsenic, and add the water-molasses mixture. The ingredients should then be stirred until they are thoroughly mixed.

Place the bait in small quantities about the plants after sundown. The cutworms feed during the night and early morning.

ACREAGE OF VEGETABLES FOR CAR-LOT SHIPMENTS

Progressive Farmer

Cabbage	3	Rutabagas	6
Tomatoes	17	Irish potatoes	7
Collards	3	Snap beans	14
Lettuce	4	Sweet corn	12
Mustard	5	Eggplant	18
Spinach	4	Cucumbers	12
Kale	4	Okra	60
Kohlrabi	4	Pepper	5
Beets	7	Peas	17
Carrots	8	Squash	14
Onions	4	Radishes	8
Turnips	6	Salsify	8

NUMBER OF SHRUBS OR PLANTS FOR AN ACRE

Distance Apart	No. of Plants	Distance Apart	No. of Plants	Distance Apart	No. of Plants
3 x3 inches	696,960	4 x 4 feet	2,722	13 x13 feet	257
4 x4 "	392,040	4½x 4½ "	2,151	14 x14 "	222
6 x6 "	174,240	5 x 1 "	8,712	15 x15 "	193
9 x9 "	77,440	5 x 2 "	4,356	16 x16 "	170
1 x1 foot	43,560	5 x 3 "	2,904	16½x16½ "	160
1½x1½ feet	19,360	5 x 4 "	2,178	17 x17 "	150
2 x1 "	21,780	5 x 5 "	1,742	18 x18 "	134
2 x2 "	10,890	5½x 5½ "	1,417	19 x19 "	120
2½x2½ "	6,960	6 x 6 "	1,210	20 x20 "	108
3 x1 "	14,520	6½x 6½ "	1,031	25 x25 "	69
3 x2 "	7,260	7 x 7 "	889	30 x30 "	48
3 x3 "	4,840	8 x 8 "	680	33 x33 "	40
3½x3½ "	3,555	9 x 9 "	537	40 x40 "	27
4 x1 "	10,890	10 x10 "	435	50 x50 "	17
4 x2 "	5,445	11 x11 "	360	60 x60 "	12
4 x3 "	3,630	12 x12 "	302	66 x66 "	10

USUAL DISTANCES APART FOR PLANTING

Vegetables	Rows, Feet Apart	Interval in Rows, Feet	Plants per Acre
Asparagus	3-4	1-2	
Beans, bush and pole	2-4	1	
Beet, early	1½-2	drills	
Beet, stock, sugar	1½-2	thin drills	
Cabbage, early	2-2½	1½-2	8712-14520
Cabbage, late	3	3	4840
Carrot	1½-2	drills	
Cauliflower	2-2½	1½-2	8712-14520
Corn, sweet	3-3½	1-2	
Celery	3-4	½-1	10890-29040
Cucumber and melons	4-6	4-6	
Eggplant	3	3	4840
Lettuce, curly	1-2	thin drills	
Lettuce, head	1½	½	58080
Onion	1½-2	drills	
Parsley	1-2	drills	
Peas	1-3	drills	
Pepper	2½	1½	11616
Potato	2½-3	1-1½	
Radish	1-1½	drills	
Rhubarb	4	2-4	2722-5445
Salsify	1½-2	drills	
Spinach	1-1½	drills	
Squash and pumpkin	6-8	6-8	
Sweet potato	3-4	1½-2	5445-7260
Turnip	1½-2	drills	
Tomato	3-4	3-4	2722-4840

Fruits and Nuts (Feet Each Way)

Apples	25-40	Grapes	8-12
Blackberries	5-6	Peaches, plums	16-20
Cherries	18-20	Pears	16-20
Citrus	15-30	Pecans	60-100
Dewberries	5-6	Persimmons	15-20
Figs	10-25	Strawberries	1½x3½

To estimate the number of plants required for an acre at any given distance multiply the distance between rows by the distance between plants, which will give the number of square feet allotted to each plant, and divide the number of square feet in an acre [43,560] by this number. The quotient will be the number of plants required.

FERTILITY REMOVED PER ACRE BY HORTICULTURAL CROPS

(University of Illinois, Henry and Morrison, *Feeds and Feeding,* Roberts, *Fertility of the Land)*

Crop	Estimated Yield	Plant Food Removed				Value of Fertility Removed [2]
		N Nitrogen	Phosphoric Acid P_2O_5	Potash K_2O	Lime CaO	
Apple (fruit)	100 bu. @ 50	4	1.5	8.5		$ 1.27
Asparagus	100 crates	18	9.5	15.0		4.65
Bean, dry	20 bu. @ 60	(48)	15.0	16.6	3.0	1.62
Beet (roots)	200 bu.	26	10.0	80.0	4.0	9.40
Cabbage heads ...	15 tons	100	102.0	87.0	51.0	30.00
Carrot	200 bu.	19	11.0	27.0		5.68
Celery [1]	250 crates	21	6.0	18.0		5.37
Corn, green ears ..	100 bu.	17	8.0	22.0	4.2	4.87
Cucumber	100 bu.	8	11.2	24.0		3.23
Lettuce	3 tons	15	8.1	36.6		5.14
Musk melon [1]	200 crates	22	9.0	32.0		6.22
Onion (bulbs) ...	500 bu. @ 56	60	25.2	61.6	44.0	16.28
Parsnip	600 bu.	90	40.0	147.0		27.00
Pea, grain	20 bu. @ 60	(44)	10.0	12.1	2.8	1.14
Pea, straw	1½ tons	(30)	2.5	26.4	59.6	1.34
Pea, green (total)	7½ tons	(85)	18.0	48.0	76.5	2.82
Peach [1]	100 bu. @ 50	4	1.5	8.5		1.27
Potato, Irish	200 bu. @ 60	42	14.4	63.6	3.4	12.12
Pumpkin	5 tons	11	16.0	32.0		5.54
Spinach [1]	3 tons	25	6.0	38.0		7.07
Sweet Potato	200 bu. @ 50	29	9.0	51.0		8.63
Tomato	500 bu. @ 50	48	28.0	142.0		17.46
Turnip	15 tons	66	39.0	87.0	21.1	19.15

1 Calculated by analogy.
2 Nitrogen, 20 cents, not counted for legume crops; phosphoric acid, 6 cents; potash, 4½ cents. Green manure would relieve the nitrogen cost.

COMPOSITION OF COMMERCIAL FERTILIZING MATERIALS

(Relative availability, given as q, quick; s, slow; m, medium; v, very.)

Nitrogen Carriers,	N%	Nitrogen Carriers,	N%
Cottonseed meal (s)	6-7	Ammonium Nitrate	32-34
Dried blood, black (m)	6-12	Nitrate of soda (q)	15-16
Dried blood, red (m)	13-14	Sulfate of ammonia (q) ..	20-21
Dried fish (s)	7-9	Tankage (s)	6-9
Dried-meat meal (s)	13-14	Tobacco stems (m)	1.5

Phosphoric Acid Carriers,	P_2O_5%
Acid phosphate (q)	14-20
Basic slag (s)	15-20
Bone meal, acidulated (q)	12-16
Bone meal, steamed (m)	25-30
Cottonseed meal (s)	2.8
Dried fish (s)	6-9
Hardwood ashes, unleached (m)	2-4
Rock phos. (Fla.) (v.s.)	18-30
Rock phos. (S. C.) (v.s.)	26-28
Rock phos. (Tenn.) (v.s.)	25-32
Tobacco stems (m)	1.5

Potash Carriers,	K_2O%
Cottonseed meal (s)	2.5
Hardwood ashes, unleached (m)	5.7
Kainit (q)	10-13
Muriate of Potash (q)	48-53
Sulfate of Potash (q)	48-50
Sulfate of Potash (low) (q)	25-28
Tobacco stems (m)	6

Lime Carriers,	CaO%
Basic slag, new process (m)	0.5
Basic slag, old process (m)	30-45
Bone meal (m)	40-60
Burned lime, fresh (q)	90-100
Ground lime rock (s)	85-95
Hydrated lime (m)	65-70
Marl (s)	20-40
Oyster shells, ground	35-40

VEGETABLE SEEDS FOR A GIVEN NUMBER OF PLANTS OR FOR AN ACRE

	Quantity per Acre
Asparagus, 1 oz. to 800 pl.	1 lb.
Beans, dwarf, 1 lb. to 100 feet drill	60 lbs.
Beans, pole, 1 lb. to 100 hills	30 lbs.
Beets, 1 oz. to 50 feet drill	5 to 6 lbs.
Broccoli, 1 oz. to 3,000 pl.	4 ozs.
Brussels sprouts, 1 oz. to 3,000 pl.	4 ozs.
Cabbage, 1 oz. to 2,500 pl.	4 ozs.
Carrot, 1 oz. to 100 feet drill	3 lbs.
Cauliflower, 1 oz. to 2,500 pl.	4 ozs.
Celery, 1 oz. to 2,500 pl.	4 ozs.
Clover, white	6 lbs.
Clover, crimson	8 lbs.
Collards, 1 oz. to 3,000 pl.	4 ozs.
Corn, sweet, ¼ lb. to 100 hills	12 lbs.
Cress, ½ oz. to 100 feet drill	3 lbs.
Cucumber, 1 oz. to 50 hills	2 lbs.
Eggplant, 1 oz. to 1,500 pl.	4 ozs.
Endive, 1 oz. to 300 feet drill	1½ lbs.
Grass, Blue, Kentucky	20 lbs.
Grass, mixed lawn	60 lbs.
Grass, perennial rye	30 lbs.
Grass, red top, fancy clean	10 lbs.
Kale, 1 oz. to 3,000 plants	5 lbs.
Kohlrabi, 1 oz. to 300 feet drill	1 lb.
Leek, 1 oz. to 200 feet drill	4 lbs.
Lettuce, 1 oz. to 120 feet drill	3 lbs.
Melon, musk, 1 oz. to 80 hills	3 lbs.
Melon, water, 1 oz. to 25 hills	5 lbs.
Okra, 1½ ozs. to 100 feet drill	8 lbs.
Onion seed, 1 oz. to 200 feet drill	4 lbs.
Onion seed, for sets	50 to 60 lbs.
Onion sets, 1 lb. to 100 feet drill	250 lbs.
Parsnip, 1 oz. to 200 feet drill	5 to 6 lbs.
Parsley, 1 oz. to 150 feet drill	3 lbs.
Peas, garden, 1 lb. to 100 feet drill	150 lbs.
Pepper, 1 oz. to 1,500 plants	8 ozs.
Potatoes, Irish	10-12 bus.
Potatoes, sweet	4-6 bus.
Pumpkin, 1 lb. to 250 hills	3 to 4 lbs.
Radish, 1 oz. to 100 feet drill	8 to 10 lbs.
Salsify, 1 oz. to 150 feet drill	8 lbs.
Spinach, 1 oz. to 100 feet drill	10 to 12 lbs.
Squash, summer, 1 oz. to 50 hills	3 lbs.
Squash, winter, 1 oz. to 25 hills	4 lbs.
Tomato, 1 oz. to 2,000 pl.	4 ozs.
Turnip, 1 oz. to 250 feet drill	1½ lbs.

GERMINATION AND LIFE OF VEGETABLE SEEDS

(1) Average percentage of germination of one-year-old seed when planted under proper conditions; (2) maximum ages in years of properly cured and stored vegetable seeds to germinate satisfactorily.

	Percentage	*Age Yrs.*		*Percentage*	*Age Yrs.*
Asparagus	90	2	Muskmelon	85	5
Bean	90	3	Okra	80	4
Beet (several seed each)	140	4	Onion	80	1
Cabbage	90	3	Parsley	70	1
Carrot	80	1	Parsnip	70	1
Cauliflower	80	4	Pea	90	2
Celery	60	2	Radish	90	2
Corn, sweet	85	1	Salsify	75	2
Cucumber	85	5	Spinach	80	3
Eggplant	75	5	Squash	85	3
Lettuce	85	4	Tomato	85	5
			Watermelon	85	5

KILLING FROSTS, DATES AND GROWING SEASONS

Competing sections may be noted by growers.

Weather Station	*Average Late Spring*	*Average First Fall*	*Days Between*
Alabama			
Birmingham	Mar. 16	Nov. 9	238
Mobile	Feb. 17	Dec. 5	291
Arizona			
Flagstaff	May 31	Sept. 24	116
Phoenix	Feb. 16	Dec. 3	290
Tucson	Mar. 11	Dec. 9	243
Yuma	Jan. 2	Dec. 25	357
Arkansas			
Fort Smith	Mar. 21	Nov. 6	230
Little Rock	Mar. 18	Nov. 14	241
California			
Eureka	Feb. 8	Nov. 26	291
Fresno	Feb. 22	Dec. 2	283
San Bernardino	Mar. 8	Nov. 22	259
Florida			
Apalachicola	Feb. 14	Dec. 7	296
Avon Park	Jan. 12	Dec. 26	348
Jacksonville	Feb. 16	Dec. 6	293
Tampa	Jan. 26	Jan. 3	342

Weather Station	*Average Late Spring*	*Average First Fall*	*Days Between*
Georgia			
Atlanta	Mar. 31	Nov. 7	221
Augusta	Mar. 22	Nov. 10	233
Macon	Mar. 23	Nov. 7	229
Savannah	Feb. 26	Nov. 24	271
Thomasville	Mar. 14	Nov. 15	246
Louisiana			
New Orleans	Jan. 25	Dec. 16	325
Shreveport	Mar. 6	Nov. 10	249
North Carolina			
Asheville	Apr. 15	Oct. 20	188
Charlotte	Mar. 28	Nov. 5	222
Raleigh	Mar. 29	Nov. 5	221
Wilmington	Mar. 23	Nov. 13	235
New Mexico			
Roswell	Apr. 12	Oct. 27	198
Santa Fe	Apr. 25	Oct. 18	176
Oklahoma			
Oklahoma City	Mar. 31	Nov. 2	216
South Carolina			
Charleston	Feb. 20	Dec. 10	293
Columbia	Mar. 18	Nov. 18	245
Greenville	Apr. 3	Nov. 2	213
Tennessee			
Chattanooga	Apr. 2	Oct. 26	207
Knoxville	Apr. 2	Oct. 28	209
Memphis	Mar. 22	Nov. 3	226
Nashville	Apr. 2	Oct. 27	208
Texas			
Abilene	Mar. 21	Nov. 10	234
Amarillo	Apr. 17	Oct. 29	195
Brownsville	Jan. 28	Dec. 22	328
Corpus Christi	Jan. 21	Dec. 28	341
Del Rio	Feb. 28	Nov. 17	262
El Paso	Mar. 14	Nov. 15	246
Fort Worth	Mar. 11	Nov. 12	246
Galveston	Jan. 19	Dec. 26	341
Palestine	Mar. 13	Nov. 13	245
San Antonio	Feb. 24	Nov. 28	277
Taylor	Mar. 13	Nov. 22	254

Weather Station	*Average Late Spring*	*Average First Fall*	*Days Between*
Virginia			
Lynchburg	Apr. 28	Oct. 27	182
Norfolk	Mar. 25	Nov. 17	237
Richmond	Apr. 7	Oct. 31	207
Wytheville	Apr. 15	Oct. 13	181
D. C.			
Washington	Apr. 8	Oct. 20	195

Diversification Pledge

Produce several money crops
Grow vegetables for home and sale
Raise fruit of several kinds
Plant trees for products and shade
Beautify home grounds
Install home conveniences
Grow flowers for house and sale

Produce milk and butter for home
Raise livestock feed on place
Feed swine for meat
Keep poultry for home needs
Plant soil-improving crops
Encourage others to do all these

INDEX

B

C

G

R